NUCLEAR SCIENCE ABSTRACTS

Volume 28 Number 9

Abstracts 20664-24074

November 15, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 28, Number 9, November 15, 1973

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

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All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summary below.

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on the post-irradiation disturbance of haemocoagulation in dogs after whole-body exposure to 600 R, 27:20122
DIERCKX, R., Determination of the fast neutron spectrum at the L54 reactor core center, 27:21880
DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20589

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  Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
ACETONE/RADIOLYSIS
  Pulse radiolysis of alkyl ketones, 27:24388
  Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
AEROSOL GENERATORS/OPERATION
  Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF--45)

Corporate Index

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21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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ORNL-		
4811	**27-21462**	**Dep. NTIS, 133p.**
4840	**27-19984**	**Dep. NTIS, 8p.**
4846	**27-21102**	**Dep. NTIS $4.00, 44p.**
ORNL-EIS-		
73-52(Vol. 1)(No.2)	**27-21978**	**Dep. NTIS, 13p.**
ORNL-NSF-EP-		
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34	**27-22016**	**Dep. NTIS, 89p.**
35	**27-22017**	**Dep. NTIS, 98p.**

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 21112, 21461, 21468, 21913–21916, 21971, 23470, 23911, 23979, 24064, 24068, and 24071.

20664 TASKS OF THE NUCLEAR AND RADIOCHEMISTRY IN ENVIRONMENTAL RESEARCH AND TECHNOLOGY. Lieser, K. H. (Technische Univ., Darmstadt, Ger.). Radiochim. Acta; 18; No. 3, 115-120(1972). (In German).

The fields of activity of environmental research and technology are explained and the importance of analytical chemistry is underlined. The paper deals with the problems connected with the operation of nuclear power plants and the utilization of radionuclides in medicine and other sectors of science and technology. The application of radiochemical methods in the determination of trace elements is discussed and particular emphasis is laid on the unrivaled possibility of using labeled compounds in the study of transport processes related to questions of environmental research and environmental protection. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 21122–21124, 21139, 21154, 21264, 21267, and 21460.

20665 (BFL-2/1973) DEVELOPMENT OF METHODS FOR THE APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE DETERMINATION OF TRACE ELEMENTS IN FOODS. 2nd Report for the Period January 1–December 31, 1972. Toeroek, G.; Schelenz, R.; Fischer, E. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany). Institut fuer Strahlentechnologie). Feb 1973. 165p. (In German). Dep. NTIS (U. S. Sales Only) $10.25.

A radiochemical separation scheme for the multielement analysis of foodstuffs by application of neutron activation was developed and a partly automated installation for processing of activated samples was built. The system was tested with six elements and the radiochemical yields were determined. The process is based upon the wet-chemical disintegration of the samples with separation of volatile elements by distillation, the selective separation of Na, K_0 and P in the residue and further separation of the residue in groups of elements or in single elements by ion exchange and gradient elution. A 8192-channel γ spectrometer connected with a Ge(Li) semiconductor detector was coupled with a computer which enables the complete evaluation of even complex γ spectra. (auth)

20666 (BNL-17932) ACTIVATION ANALYSIS STUDY OF PRECLASSIC CERAMICS FROM THE CAPACHA PHASE (COLIMA) AND EL OPENO (MICHOACAN). Harbottle, G. (Brookhaven National Lab., Upton, N. Y.). 1973. 14p. Dep. NTIS $3.00.

Two groups of Preclassic sherds from west Mexico were analyzed by neutron activation in order to determine if there was a common clay origin of both. Concentrations of the following elements in ppM are tabulated: Na, Rb, Cs, Ba, Sc, La, Ce, Eu, Lu, Hf, Th, Ta, Cr, Mn, Co, Ni, and Sb. Concentrations of K and Fe are given in percent. (JGB)

20667 (BNWL-1751(Pt.1), pp 112-113) TRACE ELEMENT CHARACTERIZATION OF URBAN AEROSOLS BY X-RAY FLUORESCENCE AND NEUTRON ACTIVATION ANALYSIS. Cooper, J. A.; Rancitelli, L. A.; Tanner, T. M. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A highly sensitive and precise instrumental technique employing x-ray fluorescence and neutron activation was developed that is capable of measuring over 40 elements on air filters used to sample urban aerosols at ground level. (auth)

20668 (CONF-721069-22) DETERMINATION OF SODIUM AND POTASSIUM IN THE NUCLEI OF SINGLE NEWT OOCYTES. Whitley, J. E.; Muir, C. (Scottish Research Reactor Centre, East Kilbride (Scotland)). 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The age-related extension and retraction of the loops of lampbrush chromosomes in amphibia may be correlated with the alkali metal content of the eggs in which they are contained. For previous analysis by atomic absorption it was necessary to pool the nucleoplasm from up to 50 eggs to obtain sufficient material for accurate determinations. The high sensitivity of neutron activation analysis and the avoidance of reagent blanks has permitted the examination of single nuclei, providing information that was obscured when larger numbers of samples were pooled. (FR)

20669 (CONF-721091-, pp P13.p1-P13.p9) USE OF CHARGED NUCLEAR PARTICLES FOR ANALYSIS. Peisach, M.; Pretorius, R. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

In activation studies the light elements and elements such as iron, for which neutron activation analysis is not sufficiently sensitive, may be determined using charged particle activation analysis. Prompt-particle spectrometry extends the activation technique and enables isotopic concentrations to be measured for most light elements. The rate of energy loss with distance in matter is much greater for charged particles than for neutrons. They can thus be used to determine elemental compositions of surfaces and the variation of the concentration of a component as a function of depth below the surface, using the energy spectrum of elastically scattered charged particles and of the prompt charged particle products from nuclear reactions. Elemental concentrations of surface layers may be determined by the excitation of characteristic x rays from surface atoms with charged particle beams. Under suitable conditions, surface concentrations of 10^{15} atoms per cm^2 can be detected and analyzed. Using well-collimated beams of charged particles directed along the channels of a crystal, the nature and position of impurities may be obtained from the scattered particles leaving the crystal along other channel directions. (auth)

20670 (CONF-721091-, pp P15.p1-P15.p8) NEUTRON ACTIVATION ANALYSIS. Turkstra, J.; de Wet, W. J. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The principles of neutron activation analysis and the various ways in which it is used for miscellaneous analytical purposes are discussed. Advantages and limitations of the technique are considered in some detail, and certain applications are illustrated by several important examples. (auth)

20671 (CONF-721091-, pp P27.p1-P27.7) NEUTRON ACTIVATION ANALYSIS IN GEOCHEMISTRY. Kable, E. J. D. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Geochemistry is concerned with the study of the distribution and migration of individual elements in the earth in space and time. Our understanding of the distribution and behavior of elements in rocks and minerals is dependent on our ability to determine them accurately and precisely. Analytical techniques currently available to the geochemist include neutron activation analysis which is considered in the light of a number of factors such as sensitivity, range of elements, and amount of material required for an analysis. (auth)

20672 (LBL-1666, pp 331-333) QUANTITATIVE NEUTRON ACTIVATION ANALYSIS OF HUMAN TISSUES. Budinger, T.; Moyer, B.; Michel, H. V.; Asaro, F.; Perlman, I. May 1973.

In nuclear chemistry annual report, 1972.

20673 (PRNC-162(App.), pp 410-420) LABORATORY METHODS. Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

Topics discussed are: cleaning glassware; lab preparation of water samples; neutron activation analysis for trace metals in suspended particles in seawater; determination of reactive phosphorus; plankton: methods and materials; procedure for collection of plankton and preparation of plankton for neutron activation analysis and atomic absorption; and nitrate and nitrite in seawater. (DHM)

20674 (PRNC-162(App.), pp 421-439) THERMAL NEUTRON ACTIVATION ANALYSIS OF AIRBORNE PARTICULATE MATTER IN THE SOUTH COASTAL AREA OF PUERTO RICO. Mo, T. Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

A study is being made to evaluate and optimize the conditions and procedures for elemental analysis of airborne particulate matter by means of neutron activation analysis and Ge(Li) techniques. Computer technique for multi-nuclide γ ray spectrometry will be applied for data reduction. (DHM)

20675 APPLICATION OF RADIOCHEMICAL METHODS IN ENVIRONMENTAL RESEARCH. Lieser, K. H. (Technische Univ., Darmstadt, Ger.). Z. Anal. Chem.; 263: No. 4, 304-307 (1973). (In German).

From 1st European analytical conference; Heidelberg, Germany (28 Aug 1972).

The suitability of radiochemical methods in the field of environmental research is explained. In particular the environmental analysis and the indicator methods are set forth and exemplified by the methods of activation analysis and isotope dilution, as well as by the application of labelled compounds e.g., for age determinations or for the study of transport processes. (GE)

20676 BORON DETERMINATION IN SOLIDS BY RECORDING α PARTICLES FROM THE REACTION $^{10}B(n,\alpha)^{7}Li$. Zverev, B. P.; Simakhin, Yu. F.; Usmanova, M. M. At. Energ. (USSR); 33: No. 2, 697(Aug 1972). (In Russian).

This paper was summarized as paper No. 597/6610 with full copy held by TIC.

The nuclear reaction $^{10}B(n,\alpha)^{7}Li$, which uses up thermal neutrons may be employed in boron determinations in any solid material. Boron is determined by recording the α-particles with a pulsed ionization chamber, which can be operated in a strong field of $\beta-\gamma$ radiation (~400 r/h) and of fast neutrons (~10^6 neutrons/cm^2·sec) from the horizontal channel of the VVR-S reactor. The background due to the charged particles generated in the reactions involving fast neutrons is reduced through judicious choice of the electrode material and of the chamber working gas. The most convenient materials for the electrodes are tin and tungsten, which do not support reactions involving emission of charged particles. The chamber filling gas used in our case was a mixture of A + N_2. The chamber background, exhibiting a continuous spectrum, was subtracted directly during the measurements, with the aid of a method for modulating the beam of thermal neutrons. The sensitivity of that method is limited by the statistical error in the determination of the number of background pulses, and is ~10^{-4} wt %. The error in the measurements due primarily to inaccuracies in the path length of the α-particles is 15 to 20%. (auth)

20677 DETERMINATION OF TOXICOLOGICALLY HAZARDOUS TRACE ELEMENTS IN MEAT BY MEANS OF ACTIVATION ANALYSIS. Hecht, H.; Mirna, A. (Bundesanstalt fuer Fleischforschung, Kulmbach, Ger.). (1972). vp. (In German).

From 9th meeting of the Federal Office for Meat Research and the Transport Society for the Federal Office for Meat Research; Kulmbach, Germany (9 Oct 1972).

Trace elements in meat are important not only from the toxicological point of view, but also with regard to the quality of meat in general. The neutron activation analysis of As, Br, Cd, Cr, Hg, Sb, Se, Sn, and Pb in meat and offals of pigs, cows, and calves is reported. The goal of this work has been amongst others to determine standard values and possible deviations for meat. Different parameters for the observed variations are discussed. The maximum permissible values of As, Pb, Cd, and Hg which have been proposed in a draft of new regulations for the FRG are compared with those currently discussed in other countries. (GE)

20678 REACTOR NEUTRON ACTIVATION ANALYSIS BY A SINGLE COMPARATOR METHOD. Lee, C. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 137-149 (Jun 1973).

A method of activation analysis, based on the irradiation and counting of an iron wire that contains manganese impurity as the single comparator, is elaborated by critical evaluation of nuclear data involved in activation and activity measurement. The variation of effective cross section is investigated as a function of the spectral index and other parameters such as a measure of the proportion of epithermal neutrons in the reactor spectrum. The errors induced by shifts in the neutron spectrum in the irradiation positions are discussed. The known amount of each element is irradiated simultaneously together with the single comparator, and the obtained values are compared with the known amount of each element. The results show that in general the random errors are not greater than those obtained by using the conventional relative method, but the systematic errors were up to about 20%. This method is applied to the determinations of fourteen rare earth elements in monazite as well as seven other elements in the standard kale powder. The satisfactory reproducibility of the present method makes possible the determination of the elements with an accuracy attainable with the conventional relative method. (auth)

20679 DETERMINATION OF IMPURITIES AND CONCENTRATION PROFILES IN SOLIDS BY DIRECT OBSERVATION OF NUCLEAR REACTIONS AND ELASTIC SCATTERING. Abel, F. (Ecole Normale Superieure, Paris). Bull. Soc. Fr. Miner. Crist.; 95: No. 6, 658-669(Nov 1972). (In French).

The principles involved in the use of light monoenergetic ion beams of about 1 MeV to analyze impurities in or on solids are presented. Two complementary techniques are described: elastic scattering (which enables elements heavier than the matrix or substrate constituents to be analyzed) and nuclear reactions specific to light isotopes. These two techniques allow the direct analysis to be made of the first few microns of a solid with a depth resolution varying according to the case considered from a few hundred to several thousand microns with a sensitivity of up to 10^{11} atoms/cm^2 in favorable cases. (FR)

20680 DETERMINATION OF SILICA AND ALUMINUM CONTAMINANTS IN NATURAL DIAMONDS BY NEUTRON ACTIVATION. Orlov, Yu. L.; Kodochigov, P. N.; Kurinov, A. D. Tr. Mineral. Muz., Akad. Nauk SSSR; No. 21, 193-195(1972). (In Russian).

Use is made of the nuclear reactions $^{27}Al(n,\gamma)^{28}Al$ and $^{28}Si(n,p)^{28}Al$. The samples are irradiated (a) with shielding by cadmium and (b) without shielding; the shielding reduces by a factor of ≃65 the effectiveness of activation of the Al. First, the samples and standards of Al and Si are irradiated for 10 min., with shielding, in a neutron flux of ≃2×10^{12} thermal neutrons and ≃1.8×10^{11} fast neutrons/cm^2/sec. The irradiated diamonds are washed with dilute HNO_3 and H_2O to remove surface contamination, and the induced activity of ^{28}Al is measured for 2 min. on a scintillation γ-spectrometer with four NaI(Tl) crystals (7 cm × 7 cm). After complete decay of ^{28}Al, the samples and standards are irradiated for a second 10-min. period, without shielding, and the ^{28}Al activity is again measured for 2 min. From the results of the two measurements the contents of Al and Si in the sample are calculated. In the diamonds investigated, the Al content ranged from 1.17 to 3.36 ppM and the Si content ranged from 0.005 to 0.010%. (Ref. Zh.)

20681 PARTIAL BODY NEUTRON ACTIVATION ANALYSIS IN VIVO: A NEW APPROACH TO THE INVESTIGATION OF METABOLIC BONE DISEASE. Catto, G. R. D.; McIntosh, J. A. R.; Macleod, M. (Univ. of Aberdeen, Scotland). Phys. Med. Biol.; 16: No. 4, 508-517(Jul 1973).

A method of detecting changes in the calcium content of a hand by neutron activation analysis is described. A 25-Ci ^{241}Am-Be source, positioned within a perspex tube, was used to provide the neutron flux. The fast neutrons were slowed by water moderation and the bones of a hand that gripped the tube were exposed to the maximum thermal neutron flux. The 3.1 MeV γ-radiation from the activated ^{49}Ca was detected by two large NaI(Tl) crystals.

The mean coefficient of variation, derived from repeated activation of anatomical specimens, was 5.0%. Serial estimations showed that the technique was a convenient and accurate indicator of metabolic bone disease as the calcium was measured directly from a relatively large mass of bone in a region of the skeleton known to be susceptible to demineralization. Successive analyses should provide quantitative information not only of the rate of progression of demineralization, but also of the response to therapy. (auth)

20682 ERROR SOURCES IN ACTIVATION ANALYSES OF ULTRAPURE MATERIALS. 3. Workshop on Activation Analysis. Martin, J. A.; Haas, E.; Fischer, G. (Siemens AG, Erlangen, Ger.). Z. Anal. Chem.; 265: No. 2, 122-128(1973). (In German).

Experience with neutron activation analyses of ultrapure materials in electronics has revealed the most important error sources and the possibilities of avoiding these. Among the trace analysis problems special attention must above all be devoted to sample homogeneity, surface impurities and, in chemical operations before irradiation, also to the blank value. Moreover, there are the dangers specific to activation analyses of specimen changes through radiation heating and radiation recoil, the development of unexpected nuclear reactions with extremely high neutron fluxes as well as the formation of hot atoms, which is disturbing in chemical separations. By means of a few examples the advantage of the location of impurities by autoradiographic techniques is shown. (auth)

20683 EXAMINATION POISSON DISTRIBUTED MEASURING VALUES. Plesch, R. (Siemens AG, Karlsruhe, Ger.). Z. Anal. Chem.; 265: No. 2, 114-121(1973). (In German).

The results of analytical measurements based on elementary events follow the Poisson distribution which is derived from fundamental principles. In practice this distribution is converted into a singular normal distribution. By combining the properties of both distributions it is possible to set up a quick test of the statistical purity of a series of measurements in order to detect the existence and kind of disturbances in measuring equipment. The criteria for determining a drift and an outlier in series of measurements are treated. (orig.)

20684 APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE DETERMINATION OF MERCURY IN FOODSTUFFS. Schelenz, R.; Diehl, J. F. (Inst. fuer Strahlentechnologie, Karlsruhe, Ger.). Z. Anal. Chem.; 265: No. 2, 93-97(1973). (In German).

A method for the determination of mercury in biological material by neutron activation, involving distillation and isotopic exchange, is described. The kinetics of mercury deposition as a function of time, pH value, volume, concentration, and stirring velocity were investigated. The detection limit of the method is 10^{-10} g Hg in 100 mg sample weight. For canned tuna the average mercury content was found to be 0.37 mg/kg with extreme values of 0.066 to 164 mg/kg and for freshwater fish 0.33 mg/kg (0.042 to 0.879 mg/kg). Nearly 150 other food samples altogether showed average mercury concentrations of 0.01 mg/kg (0.001 to 0.149 mg/kg). Compared with data published some 30 years ago, these results give no reason to believe that the mercury content of foods on the German market has increased since that time. (GE)

20685 ELEMENTAL COMPOSITION OF INDIVIDUAL CHONDRITES. Osborn, T. W.; Smith, R. H.; Schmitt, R. A. (Oregon State Univ., Corvallis). Geochim. Cosmochim. Acta; 37: No. 8, 1909-1942(Aug 1973).

Sequential nondestructive neutron activation analysis was used to determine the bulk abundance of Fe, Al, Na, Mn, Cr, Sc, Co, and Ir in approximately 300 individual chondrules from 16 chrondrites representing the H(3-5), L4, and LL(3-6) compositional and petrologic classes. For some of the chondrules, Si, Ni, Ca, and V were also determined. The histograms indicate that the most probable abundances for lithophilic elements, except Cr, are enriched in the chondrules, while the siderophilic elements are depleted in the chondrules compared to the whole chondrite. Some of the abundance populations, such as Al and Fe, appear to be multimodal. Systematic variations in the composition of the chondrules with increasing petrologic type were observed; most consistent are an increasing Na–Al and Cr–Al correlation, a decreasing Na–Mn correlation, increasing Na abundance, and decreasing Na and Mn dispersions among chondrules. The systematic compositional variations with increasing petrologic type are consistent with an increasing approach to equilibrium between chondrules and matrix. Observed elemental correlations are generally consistent with mineralogical controls expected on the basis of geochemical affinities suggested by the mineral assemblages present in the chondrules. However, a prevalent Al–Ir correlation was observed, and is most pronounced for a group of chondrules belonging to a population high in Al. A Sc–Ir correlation was observed. Also, an anti-correlation between chondrule masses and Al (and Ir for some chondrules) content of the chondrules was observed. (auth)

20686 DETERMINATION OF MERCURY IN BIOLOGICAL MATERIAL BY MEANS OF NEUTRON ACTIVATION ANALYSIS. Behne, D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Radiochim. Acta; 18: No. 3, 153-156(1972). (In German).

A simple one-step separation method for the activation analysis of mercury in biological material was developed. After destruction of the irradiated sample with a $H_3PO_4-H_2O_2$ mixture the metal is distilled from an acetic acid solution. The recovery values are higher than 99%. For the γ spectrometry ^{197}Hg can be used or ^{203}Hg as the interfering ^{75}Se is separated. The method was tested in model experiments and in the determination of mercury in a biological standard material. (auth)

20687 SIMULTANEOUS DETERMINATION OF CADMIUM AND SOME OTHER ELEMENTS IN UNPOLISHED RICE BY NEUTRON ACTIVATION ANALYSIS. Nagatsuka, S.; Tanizaki, Y. (Tokyo Metropolitan Isotope Research Center). Radioisotopes (Tokyo); 22: No. 5, 234-238(May 1973). (In Japanese).

Simultaneous determination of cadmium and some other elements in unpolished rice by nondestructive and destructive activation analysis using a high resolution Ge(Li) detector was investigated. The samples were irradiated in a thermal neutron flux of 1 to 2×10^{12} $n \cdot cm^{-2} \cdot sec^{-1}$ and the irradiation times were 10 hours for long life nuclides and 10 minutes for short life nuclides, respectively. In the destructive method, column isotopic exchange technique by sodium bromide and potassium bromide mixture was tried for the removal of ^{24}Na, ^{42}K, and ^{82}Br which were the most interfering elements in activation analysis of unpolished rice. It allowed us to remove ^{24}Na, ^{42}K, and almost all ^{82}Br simultaneously. In the analysis of unpolished rice samples produced around Fuchu City, Tokyo, Cd, Cr, Zn, Sb, Mn, Na, K, Cl, and Br were determined by nondestructive method and Cu, As, and low content of Cd were detected only by the above-mentioned destructive method. From these results, it was found that the several samples are polluted with Cd and the other elements such as Sb, Cr, and Br. (auth)

20688 IMPORTANCE OF MICRONUTRIENT STUDIES IN SOIL–PLANT RELATIONSHIP BY ACTIVATION ANALYSIS: A REVIEW. Rahman, S. M. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 41-45(Apr 1972).

Problems related to soil–plant relationship involving micronutrients can effectively be studied by activation analysis. This technique was previously used in studies of micronutrients in soils and plants. Attempts are being made in the Atomic Energy Centre, Dacca to see whether the activation program can be taken up with the existing facilities. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 21408, 21410, 23888, 23903, 23912, 23918, 23958, 23978, 23983, 24025, 24026, 24051, 24062, 24063, and 24067.

20689 (BARC-664) NEW CARRIER FOR SPECTROGRAPHIC DETERMINATION OF SILVER, MOLYBDENUM, AND CALCIUM IN URANIUM. Dixit, R. M.; Venkatasubramanian, R.; Khanna, P. P.; Sindgikar, K. S. B. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

A d.c. arc emission spectrographic method is described for simultaneous determination of silver, molybdenum, and calcium in uranium. A 1:1 mixture of antimony trioxide and barium chloride is used as a carrier. The range of estimation is 1 to 20 ppM for silver and molybdenum and 10 to 200 ppM for calcium. The average percentage standard deviation of the method is ±15%. Choice of the new carrier and effects of variation of arc parameters on the spectral line intensity of impurities are discussed. (auth)

20690 (FOA-4-4522-F-3) DETERMINATION OF URANIUM IN IRON–URANIUM ALLOYS. Gelin, B.; Helleday, E. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Jan 1973. 6p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

A method for the determination of small contents of uranium in iron–uranium alloys was developed. After dissolution of the sample in sulphuric acid and nitric acid the iron was separated through electrodeposition on a mercury cathode. Uranium and trace amounts of iron in the solution were extracted as oxinate with chloroform. Through shaking of the chloroform phase with an aqueous solution of ammonium carbonate, the uranium was

taken up in the water phase from which the uranium was extracted as oxinate with chloroform after the carbonate ions had been taken away. The concentration of uranium in the extract was determined spectrophotometrically. The precision (the standard deviation for a single determination) was around 0.4 μg uranium within limits 4 to 25 μg uranium. (Sweden)

20691 (JUL-933-RG) ATOMIC SPECTRAL ANALYSIS WITH LASER EXCITATION AND ITS APPLICATION ON THE FUEL CYCLE OF THE PEBBLE-BED REACTOR. Stupp, H. J. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Mar 1973. 176p. (In German). Dep. NTIS (U. S. Sales Only) $11.00.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The possibilities of laser application are investigated for the atomic spectral analysis (without and with electric post-excitation) under reactor conditions (40 atm He, the analysis is performed with a period of about 10 seconds) with regard to sample identification, burn-up measurement, and stinker-problems of the pebble-bed reactor. The possible influences of plasma properties-like pressure effects, charge carriers, inhomogeneities of temperature and density, and turbulences—on the emission spectral analysis (line profiles, continuous spectrum) are generally explained by literature. For the special conditions of the analysis (40 atm He, normal laser for material evaporation and plasma excitation), the knowledge on the properties of plasma-excitation and plasma emissions is extended by the analysis and high-speed photographs: Spikes of a normal laser are also absorbed in the plasma, at 40 atm of the surrounding pressure of He gas >50% (increase of intensity by about a factor of 100 compared to 1 atm); here the inverse absorption of bremsstrahlung becomes the dominating excitation mechanism; pressure effects and plasma inhomogeneities are expressed by self-absorption, inversion, asymmetric and symmetric line broadening and shifting. The time of analysis for the developed system of sample identification with doped fuel balls for 90 samples is about 150 μs, the consumption of material 5 to 10 μg, the influence of the applied doping substances on the neutron economy is only a few percents of the influence of the graphite. Some results are given concerning the burn-up measurement on the reaction of ^{12}C (n,α) ^{9}Be (detection of ^{9}Be) and some possibilities to solve the stinker problem. (auth)

20692 (RT/CHI-(73)1) CYCLIC VOLTAMMETRIC DETERMINATION OF URANIUM IN LEACHING SOLUTIONS. Casadio, S.; Orlandini, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 15 Jan 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

A rapid method to detect the uranyl content at the 10 to 100 μg/ml level in leaching solutions by using fast cyclic voltammetry at a slowly dropping mercury electrode is described. (auth)

20693 (Y-DA-5219) METHOD FOR MEASURING THE HYDROGEN CONTENT OF METALS. Powell, G. L. (Oak Ridge Y-12 Plant, Tenn. (USA)). 27 Jul 1973. Contract W-7405-eng-26. 14p. (CONF-730922-1). Dep. NTIS $3.00.

From international conference on hydrogen embrittlement effect on metal properties selection and design; Champion, Pennsylvania, USA)23 Sep 1973.

The hydrogen content of uranium alloys in the order of one weight part per million (wppM) was determined using a previously reported instrument. The instrument was designed to (a) measure, mass-spectrographically, the instantaneous rate at which hydrogen is thermally evolved from a metal sample, thus allowing the time resolution of hydrogen produced by the decomposition of surface contaminants from the hydrogen evolved from the sample bulk; (b) compute, as a function of time, the quantity of hydrogen evolved from a metal sample in the range of 0.001 wppM to 100 wppM using one-gram samples; and (c) operate under routine laboratory conditions with a sampling rate of approximately 40 samples per day. Uranium samples that were being Ni-plated were analyzed for hydrogen at various stages of the process. It was found that most of the hydrogen evolves within the first 20 seconds of the analysis. Hydrogen solubility in U–0.79% Ti alloy was studied; the relationship between hydrogen content and tensile properties of uranium alloys was also studied. (JGB)

20694 BAKABLE BLOCK-VALVES FOR THE CALIBRATION OF VERY SMALL QUANTITIES OF GAS USING ISOTOPIC DILUTION. Pagani, A.; Donville, B. (Univ., Toulouse). Vide; 27: No. 162, 249-253(Nov 1972). (In French).

An ultra high vacuum device for sampling small quantities of gas (of the order of 10^{-7} c.c. at N.T.P.) is described. The gas can be isolated into two different volumes (0.709cc and 7.51cc). In addition the device allows the quantities sampled to be calibrated by isotopic dilution. The tests which determine the conditions under which the device can be used are presented. (FR)

20695 STUDY OF THE EFFECTS OF RESIDUAL PHOSPHORUS IN TWO FERRALITIC SOILS USING VARIOUS ANALYTICAL METHODS (CHEMICAL AND ISOTOPIC). Truong, B.; Pichot, J.; Burdin, S. (Institut de Recherches Agronomiques Tropicales, Nogent-sur-Marne, France). Agron. Trop. (Paris); No. 2, 147-155(Feb 1973). (In French).

In two series of experiments to test the effect of increasing amounts of phosphorus on the yield of soils of the Hauts Plateaux of Madagascar, the tricalcic phosphate used produced important direct and residual effects on crop yields. Samples taken from different plots were analyzed using chemical and isotopic (L value) methods. The results obtained using the Saunder's method (modified Olsen method) for the determination of the L value for small pots of vegetation demonstrated the effect of phosphorus on soil fertility. Nevertheless, comparisons between the results obtained with the two ferralitic soils demonstrated the insufficience of the methods used. The methods used consider only the quantity factor, while kinetic factors appear to play an important role in the behavior of the soil. (FR)

20696 COMPARATIVE STUDY OF THE DETERMINATION OF ZINC AND MOLYBDENUM BY ATOMIC ABSORPTION SPECTROMETRY WITH A CARBON FILAMENT ATOM RESERVOIR. Johnson, D. J. (Imperial Coll. of Science and Tech., London); West, T. S.; Dagnall, R. M. Anal. Chim. Acta; 66: No. 2, 717-178(Sep 1973).

A study is made of the operating parameters and interferences in the atomic absorption determination of an element which is readily atomized (zinc) and an element which is difficult to atomize (molybdenum) with a filament atom reservoir. This device seems better suited in real situations to the determination of involatile elements such as molybdenum and in this instance especially with a hydrogen/nitrogen-sheathed gas. There were numerous interferences in the case of zinc, but only tungsten produced a significant effect in the determination of molybdenum. (auth)

20697 IMPROVED SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM WITH THIOCYANATE. Application to Ferrous Alloys. Westland, A. D.; Bezaire, J. (Univ. of Ottawa). Anal. Chim. Acta; 66: No. 2, 187-193(Sep 1973).

The selectivity of the spectrophotometric determination of niobium with thiocyanate was improved by treating the sample with hydrofluoric acid and subsequently adding aluminium ion. The procedure can be used in the presence of relatively large quantities of tantalum and iron. Accurate and rapid analyses of ferroniobium and niobium-stabilized stainless steel were carried out without the necessity of a prior separation of niobium. (auth)

20698 SPECTROPHOTOMETRIC DETERMINATION OF PLUTONIUM IN CURIUM OXIDE. Buijs, K.; Reul, J. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Anal. Chim. Acta; 66: No. 2, 304-406(Sep 1973).

In the presence of curium, the stability of Pu(VI) must be assured by the addition of an excess of oxidizing agent. Ammonium persulfate was used as the oxidizing agent and a trace of silver as the catalyst, producing a solution which was stable with regard to autoreduction. Spectrophotometric measurements were carried out in 0.5M HNO_3 solutions. Americium(III) could also be determined by this method. For Pu and Am the standard deviations were 0.007 and 0.002 mg per 50 ml, respectively. Limits of detection were 0.2% for Pu and 0.07% for Am. (JGB)

20699 LUMINESCENT DETERMINATION OF TERBIUM AND DYSPROSIUM BY USING ETHYLENEDIAMINETETRAACETATE AND 1,2-DIOXYBENZENE-3,5-DISULFONIC ACID. Tishchenko, M. A.; Alakaeva, L. A.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Kiev). Ukr. Khim. Zh.; 39: No. 5, 482-485 (May 1973). (In Russian).

A luminescent method for the determination of Tb and Dy in the presence of other rare earth elements by using the reaction of the formation of compound complexes with 1,2-dioxybenzene-3,5-disulfonic acid and ethylenediaminetetraacetate is proposed. The sensitivity of the method is 1×10^{-3} μg/ml for Tb_4O_7 and 1×10^{-4} μg/ml for Dy_2O_3. Rare earth element impurities do not interfere with the determination. (tr-auth)

20700 METALLIC COMPLEXES OF CHLORANILIC ACID. II. Complexes of Uranium(VI). Marone, C. B.; Bianchi, G. (Univ. Nacional de Cuyo, San Luis, Argentina). An. Quim.; 69: No. 2, 205-215(Feb 1973). (In Spanish).

Chloranilic acid (AH_2) (2,5-dichloro-3,6-dihydroxy-p-benzoquinone) reacts with U(VI) to form, at pH = 4, an anionic complex of 2 : 1 mole ratio, probably AUO_2^{2-}. This compound remains undissolved in chloroform, benzene or butyl alcohol. As the acidity increases the above complex is destroyed giving a discharged sort of stoichiometry 1 : 1 with stability constant of $1.02 \pm 0.02 \times 10^2$ at ionic strength 0.2. At pH = 2, with butyl alcohol, $E\%_{max}$ = 80 is obtained. The extracted compound has 1 : 1 mole ratio, being K_{ext} =

42 ± 3. Its aqueous dissolutions obey Beer's law between 0.2 and 7.6 ppM of U(VI) and it has an ϵ mol. app. = 29,200 ± 600 at 350 nm for pH = 2.5. The spectrophotometric determination can be practiced by previous separation of tetrapropylammonium uranyl trinitrate into isobutyl methyl ketone. From 35 ions extracted, only Hg(I) and Hg(II) interfere seriously when they are in 1:1 mole ratio with respect to U(VI) in the original sample. (auth)

20701 REACTION OF URANYL IONS WITH PHLOREIN. Lasovsky, J.; Ruzicka, E. (Palacky Univ., Olomouc, Czechoslovakia). Collect. Czech. Chem. Commun.; 38: No. 6, 1659-1667(Jun 1973). (In German).

The reaction of UO_2^{2+} ions with Phlorein (1,7,9-trihydroxy-3-phenoxazin-3-one) was studied spectrophotometrically as well as polarographically. The studies demonstrated that two complexes were formed with a ratio of the components of one to one. By means of a digital computer, both the stability constants and the mole extinction coefficients were determined. The photometric uranium determination was elaborated for the weak alkaline medium of a triethanolamine buffer in the presence of Chelaton 3. (tr-auth)

20702 PHENOTHIAZINE DERIVATIVES AS NEW REAGENTS IN QUANTITATIVE ANALYSIS. III. Extractive-Colorimetric Method of Determination of Molybdenum by Means of Chloropromazine, Methopromazine, and Diethazine. Tarasiewicz, M.; Puzanowska-Tarasiewicz, H. (School of Engineering, Bialystok, Poland). Chem. Anal. (Warsaw); 18: No. 3, 599-607(1973). (In Polish).

Phenothiazine derivatives (PF): chloropromazine, methopromazine, and diethazine react in an acid medium with thiocyanate complexes of molybdenum(V) forming orange colored compounds, sparingly soluble in water, of the following formula: $(PF{\cdot}H)[MoO(SCN)_4]$. The quantitative extraction of these compounds was advantageously used for elaboration of an extractive-colorimetric method of molybdenum determination. The method consists of chloroform extraction of the above mentioned compounds from aqueous medium ($C_{H_2SO_4}$ = 2.0 N, C_{NH_4SCN} = 1.5 M) and absorbance measurement at λ = 465 nm. The Beer's law is valid at the concentrations ranging from 1 to 10 μg Mo/cm^3. The time of analysis amounts to approx. 20 minutes. In the determination Co(II), Cu(II), Bi(III), Fe(III), Ti(IV), W(V), U(VI) interfere. (auth)

20703 QUALITATIVE CHROMATOGRAPHIC ANALYSIS OF THE PLATINUM METALS AND GOLD ON PAPER IMPREGNATED WITH AMBERLITE LA-1 HYDROCHLORIDE. Przeszlakowski, S.; Flieger, A. (Dept. of Inorganic and Analytical Chemistry, Lublin). J. Chromatogr.; 81: No. 1, 129-135(27 Jun 1973).

Mixtures of Au(III), Ru(III), Rh(III), Pd(II), Os(III), Ir(III), and Pt(IV) were analyzed qualitatively by reversed phase extraction chromatography on paper impregnated with Amberlite LA-1 hydrochloride and developed with 6M HCl using the descending or circular technique or Matthias' method. The sensitivities of color tests for the metals investigated were also determined. The time of analysis depends on the chromatographic technique applied and varies from 1 h (circular technique) to 3.5 h (Matthias' method). (auth)

20704 USE OF A LASER FOR DETERMINATION OF RARE EARTHS IN ZIRCONIUM. Krivchikova, E. P.; Vasil'eva, N. M. Zh. Anal. Khim.; 28: No. 5, 928-932(May 1973). (In Russian).

A method was developed for atomic absorption analysis of metallic zirconium for rare earth impurities in a laser radiation source. A comparison of the data of the atomic absorption analysis with the standard chemical one was satisfactory. (auth)

20705 SPECTROPHOTOMETRIC DETERMINATION OF ACTINIUM. Karalova, Z. H.; Myasoedov, B. F.; Rodionova, L. M. Zh. Anal. Khim.; 28: No. 5, 942-945(May 1973). (In Russian).

The absorption of actinium in $HClO_4$ solutions and its colorimetric reaction with arsenazo III were studied. Actinium in 1M $HClO_4$ absorbs in the uv region; λ_{max} = 250 nm, E = 7.5 × 10^2. Actinium forms 1:1 and 1:2 complexes with arsenazo III. The molar extinction coefficients at 660 nm are 1.9 × 10^4 and 3.8 × 10^4, respectively. (auth)

20706 DETERMINATION OF IMPURITIES IN AMERICIUM BY USING A HOLLOW CATHODE. Zakharov, E. A.; Myasoedov, B. F.; Karyakin, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 5, 879-885(May 1973). (In Russian).

The use of a hollow cathode for the analysis of americium for impurities provides for the removal of the effect of the main component, and therefore, the determination of conventional impurities with high absolute sensitivity and a coefficient of variation of between 30 and 50%. Up to 87% of the Am can be directly regenerated from a hollow graphite cathode. The presence of impurities slightly affects the yield of americium from the cathode. (auth)

20707 SOME ANALYTICAL PECULIARITIES OF THE HIGH-FREQUENCY TORCH DISCHARGE IN SPECTRAL ANALYSIS OF SOLUTIONS. Pupyshev, A. A.; Muzgin, V. N. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Anal. Khim.; 28: No. 5, 890-896 (May 1973). (In Russian).

Peculiarities of the mutual effect of elements in the high-frequency torch discharge in case of introducing the solutions by means of ultrasonic and pneumatic sprayers were studied. The observed effect cannot be explained by the change of the generator parameters. The shape of the functional dependence of the intensity of spectral lines on the concentration of easily ionized elements in the solution is conditioned considerably by the concentration of the water vapor in the discharge plasma. A method was developed for determination of the components of a lanthanum–cobalt alloy (50 to 90% Co) with the relative error of 0.6%. (auth)

20708 ANTIPYRINE DERIVATIVES AS REAGENTS FOR AMPEROMETRIC TITRATION OF HETEROPOLYCOMPOUNDS. Communication 3. Determination of Molybdenum. Lugovoi, S. V.; Odud, Z. Z. (Magnitogorsh Mining and Metallurgical Inst., USSR). Zh. Anal. Khim.; 28: No. 5, 950-955(May 1973). (In Russian).

The precipitation of molybdates with diantipyrylmethane was studied. Conditions under which molybdate is not precipitated during the titration of molybdenum heteropoly-acids were found. Optimal conditions were found for the titration of molybdenum by binding it into molybdenosilicate and precipitation with diantipyrylmethane by the simplex planning method. The sensitivity is 0.04 mg/ml. The method permits the determination of molybdenum and silicon from a single sample. (auth)

20709 CATALYTIC WAVE OF BROMATE IONS ON A ROTATING GRAPHITE DISC ELECTRODE IN THE PRESENCE OF MOLYBDENUM(VI). Toropova, V. F.; Vekslina, V. A.; Chovnyk, N. G. (Kazan State Univ.). Zh. Anal. Khim.; 28: No. 5, 967-971(May 1973). (In Russian).

Two catalytic waves appear on a rotating graphite electrode in $KBrO_3$ solutions in the presence of Mo(VI) and its complexes with EDTA and sodium sulfosalicylate. A wave, observed at a more positive potential than that of Mo(VI) reduction, can be used for determining nanogram amounts of molybdenum. (auth)

20710 CHEMICAL–SPECTRAL ANALYSIS OF TUNGSTEN–RHENIUM ALLOYS. Tarasevich, N. I.; Chebotarev, V. E. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 5, 1023-1025(May 1973). (In Russian).

A method was developed for the chemical-spectral analysis of tungsten–rhenium alloys for Si, Fe, Mg, Ca, Ni, Al, Mo. The range of determinable concentrations is n × 10^{-2} to n × 10^{-4}%; the relative standard deviation is 0.12 to 0.21. (auth)

20711 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM WITH PYROCATECHOL VIOLET IN THE PRESENCE OF CETYLPYRIDINIUM BROMIDE. Nakashima, R.; Sasaki, S.; Shibata, S. (Government Industrial Research Inst., Nagoya, Japan). Jap. Anal.; 22: No. 6, 723-729(Jun 1973). (In Japanese).

The procedure is as follows; A 0.2 to 1.0 ml aliquot of a standard solution of niobium containing 40% (v/v) sulfuric acid (niobium: 5.0 to 50 μg) was taken and 0.5 to 1.0 ml of 40% (v/v) sulfuric acid was added. Then 2.0 ml of 0.1% pyrocatechol violet (PV) solution, 2.5 ml of saturated potassium chloride solution and 3.0 ml of 5.0 × 10^{-3} M cetylpyridinium bromide (CPB) solution were added. The solution was diluted to 15 to 20 ml, pH was adjusted and diluted exactly to 25 ml with a volumetric flask. Absorbances were measured at 565 nm against the reagents blank. For determining the molar ratio of niobium to PV in the complex, continuous variation method was carried out. The results showed that the molar ratio was 1:4 regardless of the presence of CPB. Calibration curves were linear from 0.2 to 2.0 μg/ml of niobium. The optimum pH range was 0.8 to 1.6. (DHM)

20712 2,3,7-TRIHYDROXY-9-(2-QUINOLYL)-ISOXANTHENONE-(6) (2′-QUINOLYLFLUORONE) AND ITS USE FOR THE PHOTOMETRIC DETERMINATION OF ZIRCONIUM. Asmus, E.; Klank, W. (Technische Univ., Berlin). Z. Anal. Chem.; 265: No. 4, 260-266(1973). (In German).

A report is given on the preparation and properties of 2′-quinolylfluorone. In acid solution the reagent forms various complexes with zirconium. Owing to its extremely high extinction coefficient ϵ_{max} = 165,000 the 1:4-complex can be used for quantitative determination of zirconium. In the concentration range 0.4 to 10 nmoles/ml the variation coefficients are 0.5 to 2.8% rel. (auth)

20713 PHOTOMETRIC DETERMINATION OF ZIRCONIUM OXYCHLORIDE IN TABLE SALT. Asmus, E. (Technische Univ.,

Berlin); Klank, W. Z. Anal. Chem.; 265: No. 4, 267-268(1973). (In German).

2'-Quinolylfluorone forms a 1:4 complex with zirconium. Owing to its high extinction coefficient ϵ_{max} = 165,000 at λ = 539 nm the complex can be used for the determination of $ZrOCl_2$ in table salt. (auth)

20714 DETERMINATION OF COPPER, IRON, LEAD, AND ZINC IN YTTRIUM OXIDE AND YTTRIUM OXIDE SULFIDE BY ATOMIC ABSORPTION SPECTROMETRY. Ishizuka, T.; Sunahara, H.; Tanaka, K. (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku; 21: No. 12, 385-390(Dec 1972). (In Japanese).

The determination of copper, iron, lead, and zinc in yttrium oxide and yttrium oxide sulfide was performed by atomic absorption spectrometry after extracting these elements with ammonium pyrrolidine dithiocarbamate (APDC)–methyl isobutyl ketone (MIBK). The optimum pH range for the extraction of these elements is 3 to 4. The extraction is performed in 2:1 volume ratio (R) of the aqueous solution to MIBK. At R = 2, copper and lead are extracted over 98%, while iron only 85%, and zinc only 80%. However, high reproducibility of extraction of iron (±4%) and zinc (±3%) makes a single extraction sufficient for the present purpose. The extraction of each metal is not affected by the presence of a large amount of yttrium. A sample of yttrium oxide or yttrium oxide sulfide is dissolved in aqua regia, adjusted to pH 3, extracted by APDC-MIBK, and determined by the atomic absorption method. Amounts in ppM order of these elements are found as impurity in the samples, and the coefficients of variation are 2.7 to 5.3% for copper, 3.3 to 14.2% for iron, 4.0 to 11.1% for lead and 0.7 to 12.3% for zinc. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 20760, 21070, 21074, 21102, 21134, 21271, 21276, 21400, 21431, 21846, 22081, and 23698.

20715 (ARH-SA-160) DETERMINATION OF RARE EARTHS IN PLUTONIUM BY X-RAY EMISSION ANALYSIS. Miller, A. G. (Atlantic Richfield Hanford Co., Richland, Wash.). Aug 1973. Contract AT(45-1)-2130. 24p. (CONF-730827-1). Dep. NTIS $3.25.

From 15th annual rocky mountain spectroscopy conference; Denver, Colorado, USA (21 Aug 1973).

A sensitive and accurate method for measuring trace rare earths in plutonium or uranium by x-ray emission analysis was developed. Plutonium is separated from the rare earths by solvent extraction using tri-isooctylamine. The rare earths are then carrier-precipitated as fluorides and collected on a Millipore filter in an "infinitely" thin layer. The rare earths on the filter are counted and ratioed to an internal standard, terbium. This work has dealt with samarium, europium, gadolinium, dysprosium, and the elements that produce spectral interferences. However, the method is equally applicable to the other rare earths, assuming spectral interferences are avoided. Detection limits are on the order of 0.1 μg in 100 mg of plutonium oxide. The pooled standard deviation for spike recoveries of the four rare earths at the 1 μg level is 8%. (auth)

20716 (BNWL-1751(Pt.1), pp 143-144) SEQUENTIAL PROCEDURE FOR MEASURING ^{239}Pu, ^{238}Pu, ^{241}Am, ^{90}Sr, AND ^{55}Fe IN AIR SAMPLES. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A method for sequential removal of Am, Pu, Sr, and Fe from a large membrane filter is described. After fusion of the sample, ^{90}Sr is precipitated with fuming HNO_3 and determined radiochemically. Plutonium is retained on an ion exchange column (Dowex 1-X8, Cl^- form) and eluted with HCl containing HI. After electrodeposition the plutonium isotopes are alpha counted. Americium and iron are retained on an ion exchange column (Dowex 50-X8, H^+ form). The ^{55}Fe is then eluted with 3 M HCl and determined by a standard radiochemical procedure. The ^{241}Am is eluted with 7 M HCl and determined by a standard radiochemical procedure. (DHM)

20717 (CEA-CONF-2250) APPLICABILITY OF X-RAY FLUORESCENCE IN CHEMICAL ANALYSIS. Baudin, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 32p. (In French). (CONF-721225-2). Dep. NTIS (U. S. Sales Only) $3.75.

From meeting on analysis using x-ray fluorescence and emission spectra; Malakoff, France (20 Dec 1972).

The principles of x-ray fluorescence analysis are presented together with the characteristics of the x-ray spectra emitted following bombardment with electron or photon beams and radiation from radioactive sources. Gas and semiconductor detectors are described and compared. Two types of equipment are defined: spatial dispersion and energy selection. The range of applicability of the method is between $^1/_{10}$ and a few percent. (FR)

20718 (PRNC-162(App.), pp 440-444) STRONTIUM-89 AND 90 IN MILK AND IODINE-131 IN MILK. Wood, G. G. Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

Techniques are described for determining ^{131}I in milk by γ spectroscopy and for determining ^{89}Sr and ^{90}Sr in milk by ion exchange or ashing and γ counting. (DHM)

20719 RAPID METHOD FOR THE ASSAY OF RADIOACTIVE NUCLIDES IN SEA WATER. Miyake, H.; Michijima, M. (Kobe Univ. of Mercantile Marine, Japan). Kobe Shosen Diagaku Kiyo. Dai-2-rui. Kokai, Kikan, Rigaku-hen; No. 20, 239-245(Jan 1973). (In Japanese).

A rapid method for collection and spectrometric analysis with a Ge(Li) detector of radioactive nuclides in sea water was studied. Collection efficiencies for ^{144}Ce, ^{103}Ru, ^{95}Zr, ^{95}Nb, ^{65}Zn, and ^{60}Co with activated carbon were measured. Effects of concentration of activated carbon and pH on the collection efficiencies were studied. Adding 0.5 g of powdered activated carbon to 1 liter of sea water adjusted pH at 9.9 with 4 ml of 1N sodium hydroxide solution, above 90% of ^{144}Ce, ^{95}Zr, ^{95}Nb, ^{65}Zn, and ^{60}Co and above 80% of ^{103}Ru were collected. The assay of surface sea water was carried out on board with this method. The filtering of 80 l of sea water was completed in a few hours. Fallout radionuclides such as ^{103}Ru, ^{95}Zr, of which concentrations were below 0.05 pCi/l could be detected with a 42.7 cm^3 Ge(Li) detector counted at intervals of 1,000 minutes for the sample obtained from 80 l of sea water. (auth)

20720 SIMPLE, CONVENIENT INTEGRATOR FOR CHART RECORDERS OF RADIOACTIVITY. Lloyd-Jones, C. P. (Research Station, Bristol, Eng.). Chem. Ind. (London); No. 17, 680-681(1972).

Counts are accumulated by a batch counter, and the marker pen is activated after a predetermined number of counts. When used in association with a conventional recorder this technique will provide quantitative results even when the rate-meter or chart recorder is overloaded. The integrator was used for determining ^{14}C in eluates from an amino-acid analyzer. (Anal. Abstr.)

20721 ISOTOPE-EXCITED X-RAY FLUORESCENCE ANALYSIS OF BINARY ALLOYS USING ENERGY DISPERSION. Laine, E.; Tukia, L. (Turku Univ., Finland). X-Ray Spectrum.; 2: No. 3, 115-119(Jul 1973).

A radioisotope-excited x-ray fluorescence method for the analysis of binary alloys is presented. In this energy dispersion analysis no standard specimens were needed. The method was applied to copper–antimony alloys. The results checked by another energy dispersion method based on x-ray diffraction. X-ray photons from the specimen were measured with an Si(Li) detector and a multichannel analyzer was used to sort out the energies. The data were recorded on punched paper tape for computer processing. (auth)

20722 DETERMINATION OF RADON IN WATER. Somko, V. A. Gig. Sanit.; No. 5, 94-96(May 1973). (In Russian).

A commonly used radiometer and scaling circuit is recommended in determining Rn in water. A 0.001 μCi ^{226}Rn source was used to calibrate the equipment, and details of its physical arrangement are diagrammed and discussed. (KSW)

20723 LIQUID SCINTILLATION COUNTING OF ^{14}C- AND ^{3}H-LABELED SAMPLES ON SOLID SUPPORTS: A GENERAL SOLUTION OF THE PROBLEM. McKenzie, R. M.; Gholson, R. K. (Oklahoma State Univ., Stillwater). Anal. Biochem.; 54: No. 1, 17-31(Jul 1973).

The data presented demonstrate the potential of surfactant-fortified scintillation cocktails in overcoming many of the problems encountered in the quantitation of radioactivity on solid supports. Using a broad range of representative ionic and polar biochemical compounds, the in vial elution and quantitative recovery of ^{3}H and ^{14}C-labeled components from a wide assortment of common solid support media was demonstrated. This methodology in combination with zero elution counting systems and in some circumstances gelled suspension counting should combine to overcome most of the problems associated with determination of isotopic activity on such solid support media. (auth)

20724 COLORIMETRIC DETERMINATION OF MOLYBDENUM AND TITANIUM IN CHLOROPLATINIC ACID. Rozycki, C.; Suszczewski, W. (Technical Univ., Warsaw). Chem. Anal. (Warsaw); 18: No. 3, 621-624(1973). (In Polish).

Molybdenum and titanium are separated from a solution of chloroplatinic acid by precipitating them with 5 mg of Al in presence of 5 mg of Pb at pH 5.4 to 5.5. The precipitation is carried out from solutions 0.25 M in respect to sodium nitrate (coagulates the sediment) with a diluted solution of sodium hydroxide. The precipitate obtained is dissolved in 5 ccm of hydrochloric acid (2 + 3). After adding 3 ccm of 20% solution of ascorbinic acid, 2 ccm of 6 M KSCN and 0.1 ccm of 0.04% $CuSO_4$ the thiocyanate complex of molybdenum is extracted with 5 ccm of 15% TBP in $CHCl_3$. The organic phase is diluted with chloroform up to 10 ccm and absorption is measured at 470 nm. After the extraction of molybdenum to the aqueous phase 0.5 ccm of concentrated HCl and 0.2 g of NaI were added. After 10 minutes platinum is extracted (it may be coprecipitated with Mo and Ti and it hinders the determination of Ti) with 10 ccm of 15% TBP in hexane. To the aqueous phase obtained there are added 2.5 ccm of 6 M KSCM, 2.5 ccm of 5% diantipyryl solution in 2 M HCl and 1 ccm of 10% stannous chloride in 2 M HCl. Titanium is then extracted twice with 5 ccm of $CHCl_3$. Combined organic phases are diluted up to 25 ccm with chloroform and absorption measured at 420 nm. This method was used to determine 9.8×10^{-4}% Mo and 1.0×10^{-3}% Ti in a chloroplatinic acid solution (titanium was added in form of the standard). Standard deviation for Mo amounted to 0.8×10^{-4}%, while that for Ti was -0.5×10^{-5}%. (auth)

20725 MEASUREMENT OF THE SPECIFIC RADIOACTIVITY OF WATER WITH HIGH SALT CONTENTS. Grossman, A.; Kwapulinski, J. (Politechnika Slaska, Gliwice, Poland). Przegl. Geofiz.; 17: No. 25, 155-164(1972). (In Polish).

The conventional method of determining the global beta radioactivity is not suitable for waters with weak radioactive properties, but with high content of mineral salts (such as bottom waters in the mines), since they require very long times, sometimes many hours, of exposure. In such troublesome circumstances, it is suitable to use the so-called method of thick layer with simultaneous lowering of the proper measuring instruments by applying the anticoincidence system. Application of the method of thick layer, not requiring any special instrumentation, assures a very distinct improvement of the measured parameters. (auth)

20726 TRACE SUBSTANCES IN ENVIRONMENTAL HEALTH. VI. Proceedings of the 6th Annual Conference, Columbia, Missouri, June 13–15, 1972. Hemphill, D. D. (ed.). Columbia, MO; University of Missouri (1973). 411p. (CONF-720684–).

Fifty papers were presented and abstracts were prepared for two of the papers. (DHM)

For abstracts of individual papers see: 20727 and 20728.

20727 TRACE METAL ANALYSIS USING X-RAY FLUORESCENCE AND ELECTRON SPECTROSCOPY. Cothern, C. R.; Brown, C. D.; Blasius, M. B. (Univ. of Dayton, OH). pp 285-289 of Trace Substances in Environmental Health. VI. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From sixth annual conference on trace substances in environmental health; Columbia, Missouri, USA (13 Jun 1972). See CONF-720684-.

Advantages for determining the presence and concentration of trace metals by x-ray fluorescence are: the method is nondestructive, simple data analysis, detection of all metals simultaneously, and it is portable. The samples examined can be prepared immediately upon collection, thus eliminating the problem of absorption of metals on the collection container. Recent work has shown that sensitivities in the range of 20 ppB can be achieved when working with water samples, and sensitivities in the range of 500 ppB can be achieved with air samples. These sensitivities were achieved using a bremsstrahlung exciting source and by optimizing the geometry factors. One disadvantage of XRF is the "matrix effects"; however in most cases these can be corrected for or minimized by appropriate sample preparation. Because of the material covering the X-ray detector only elements above Cl in the periodic table can be detected. A problem that arises in XRF, as it does in all analytical techniques, is that of obtaining good standards. Using the technique of vacuum deposition, good results have been obtained for XRF standards in our laboratory, but the trace metal field in general is in need of better standards, and we have been unable to find good available calibration standards. In order to develop a more comprehensive analysis program and also identify the kind of molecule the metal resides in, a program has been started using electron spectroscopy (ESCA). ESCA spectra of zinc compounds were examined, and a preliminary study shows promise for the identification of molecules in the ppM range in water samples containing metals. (auth)

20728 RAPID TRACE ELEMENT ANALYSIS OF NAIL CLIPPINGS BY X-RAY FLUORESCENCE. Copper, J. A.; Langford, J. C. (Battelle Pacific Northwest Lab., Richland, WA). pp 315-321 of Trace Substances in Environmental Health. VI. Hemphill, D. D. (ed.). Columbia, MO; Univ. of Missouri (1973).

From sixth annual conference on trace substances in environmental health; Columbia, Missouri, USA (13 Jun 1972). See CONF-720684-.

A rapid and sensitive technique for the multielement analysis of trace elements in nail clippings was developed. The technique is based on excitation of the characteristic x-rays of the elements with a high-intensity radioisotopic source and their analysis using a Si(Li) X-ray energy analyzer. Eighteen elements were observed and include S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Se, Br, Sr, Zr, and Pb. Lead was observed in 98% of the nail samples with levels 10 to 100 fold higher than normal blood levels. The average value for the Zn : Cu ratio of 8 : 1 observed for nails of individuals with cystic fibrosis showed about the same distribution as the Zn : Cu ratio for nails from normal individuals. The technique is shown to be of wide application in the study of trace elements in screening, diagnosis and epidemiological studies, and can be easily automated. (auth)

20729 X-RAY FLUORESCENCE MICROANALYSIS OF THIN BIOLOGICAL SPECIMENS. Nicholson, W. A. P.; Hall, T. A. (Cambridge Univ., Eng.). J. Phys., E (London); 6: No. 8, 781-784(Aug 1973).

An x-ray fluorescence unit was designed for the microanalysis of thin biological specimens. Excitation is by means of a microfocus x-ray tube with transmission anode, and the x-ray spectroscopy is based on a Si(Li) detector. Tests show that the unit in its present form can measure amounts of potassium down to approximately 10 pg and potassium mass fractions down to approximately 30 ppM. Quantitative analysis is based on a normalization of the fluorescence signal against the measured intensity of scattered radiation. (auth)

20730 NEW METHOD FOR THE MEASUREMENT OF BONE MINERAL CONTENT USING BOTH TRANSMITTED AND SCATTERED BEAMS OF GAMMA-RAYS. Clarke, R. L.; Van Dyk, G. (Carleton Univ., Ottawa). Phys. Med. Biol.; 16: No. 4, 532-539 (Jul 1973).

Two related methods are described for determination of the electron density of a small selected volume within an irregular non-uniform object. The immediate medical application for these methods is in the direct measurement of mineral content of bone. The methods involve the manipulation of two beams of γ rays. Four intensities are measured, two of transmitted beams and two of a scattered radiation. The difference between the two techniques lies in the ranges of energies of γ rays that can be used. Preliminary experiments show that there is no dependence on the size of the test object, and that the relative electron density measurements are in good agreement with calculated values. The value of corresponding practical devices for the determination of bone mineral content is discussed. (auth)

20731 SIMPLIFIED METHOD FOR THE MEASUREMENT OF IODINE-125 IN BIOLOGICAL MATERIALS BY LIQUID SCINTILLATION COUNTER. Kubodera, A.; Tsurufuji, S. (Science Univ. of Tokyo). Radioisotopes (Tokyo); 22: No. 4, 165-169(May 1973). (In Japanese).

Simple and reproducible counting methods of ^{125}I in tissue or blood by liquid scintillation counter were investigated. It is elaborative and time consuming to pretreat the sample blood or tissue for the purpose of dissolving or suspending the samples in scintillator. A study was made of the method of dipping the tube containing each sample into liquid scintillation counter vial that contains liquid scintillator. Since according to this method, the sample does not contact with liquid scintillator, it is possible to recover the sample and to reutilize the scintillator. In addition, it is also possible to measure the radioactivity of ^{125}I in biological materials with satisfiable reproducibility. (auth)

20732 RADIOMETRIC DETERMINATION OF THORIUM IN BAUXITES AND RED MUDS. Weinreich, R. (Univ., Mainz); Winkhaus, G. Erzmetall; 25: No. 2, 54-57(1972). (In German).

The thorium content of bauxites of different origin and of some red muds was nondestructively determined by evaluation of the 2.62 MeV γ radiation of the thorium daughter ^{208}Tl(ThC''). It has been confirmed that thorium in the studied samples is in a radioactive equilibrium with its decay products. (GE)

20733 ANALYSIS OF RADIOIODINE. Nakhutin, I. E.; Rastunov, L. N.; Smirnova, N. M. (State Committee on Atomic Energy, Moscow). pp 79-86 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973). (In Russian).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

The problem of analyzing radioiodine in the atmosphere is considered. An all-purpose method providing a general analysis is the adsorption of radioiodine on activated charcoal or on a bundle of filters containing activated charcoal. The iodine compounds can be detected, and their contribution to the overall activity determined, from the iodine distribution in the analytical column and the slope angles of curves plotted on the co-ordinates 1g C(χ). Individual compounds can be identified by means of gas–liquid chromatography. Columns containing citric acid, triisopropyl ether, or triphenyl phosphate show separation of a mixture of 7-component iodohydrocarbons, including the unsaturated type, but the triphenyl phosphate column is less efficient. (auth)

Separation Procedures

Refer also to abstracts 23935, 23969, and 24047.

20734 (CEA-R-4440) SEPARATION OF LANTHANIDES USING SA-2 PAPER ION EXCHANGER CHROMATOGRAPHY: STUDIES AND APPLICATIONS. Dubuquoy, C.; Gusmini, S.; Poupard, D.; Verry, M. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Aug 1973. 43p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

A synthesis of work accomplished on the separation of rare earths using SA-2 paper ion exchange chromatography is presented. This method can be used for radiochemical analysis and trace analysis. The following complexing agents were studied: lactic acid, α-hydroxyisobutyric acid, and α-hydroxy-α-methylbutyric acid. The radiochemical purity of the elements separated was conserved by attempting to increase the quantities of carrier present. The technical problems encountered are exposed (deposits, impurities, localization of stains). Some immediate applications are described. (auth)

20735 (COO-3469-1) STUDIES IN SOLUTION AND NUCLEAR CHEMISTRY. Final Report. Marinsky, J. A. (State Univ. of New York, Buffalo. Dept. of Chemistry). 1 Jul 1973. Contract AT(11-1)-3469. 44p. Dep. NTIS $4.25.

A summary is presented of research that was conducted (1) to elucidate the ion-exchange phenomenon (2) to study the solution chemistry of the alkali metals, the alkaline earths, and the transition elements in the presence of linear and cross-linked polyelectrolytes, (3) to investigate the solution chemistry of the alkali metal and the lighter rare earth metal ions and (4) to extend theoretical development of polyelectrolyte models for the knowledgeable interpretation of experimental results under items (1) and (2). Various ion-forms of Dowex-50 and IRC-50, their polyelectrolyte analogs, polystyrene sulfonic acid and polymethacrylic acid as well as polyacrylic, polyglutamic, and polyaspartic acid were used to facilitate these objectives. In addition, an investigation of the ion-selectivity of Linde-A zeolite in aqueous and mixed media was conducted to facilitate attainment of objective 1. An educated estimate of the physical chemical behavior of mixtures of alkali metal salts in aqueous and mixed media was provided by these studies. Insight with respect to the important parameters that are operative in the zeolite for determining solvent selectivity in this zeolite was also obtained from these studies. Ion exchange, polarographic, potentiometric, spectral (uv, visible, ORD, Mossbauer), osmotic, magnetic and calorimetric measurements were made to accomplish the goals of this program. Laser solution, and acidity function studies were also carried out in the course of this research program. In addition, selected nuclear studies of radioactive nuclides of Ga, Sn, and Tc formed in ^{235}U fission were carried out. Independent fission yield measurements of several Tc nuclides were made. (auth)

20736 (FRNC-TH-368) LIQUID–LIQUID EXTRACTION FROM MOLTEN ALKALI NITRATES CONTAINING 4f AND 5f ELEMENTS USING DIPHOSPHINE DIOXIDES. Application to the Development of Selective Electrodes. Mesplede, J. (Lyon Univ. (France)). 1972. 108p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

Results are presented on the extraction of Co(II) and some 4f (Pr, Eu, Tm) and 5f (Am, Cm, Cf) elements from the $LiNO_3$–KNO_3 eutectic using $(C_6H_5)_2$ P(O) (CH_2)n P(O) $(C_6H_5)_2$ [n = 2, 3, 4, 5, and 6] type diphosphine oxides. These neutral organophosphors present two P(O) groups separated by a variable length carbonated chain. The effect of different values of n on the extraction power of diphosphine dioxide was studied. An attempt was made to utilize the results obtained for the Co distribution in order to develop a selective liquid membrane electrode for determining the activity of the Co^{2+} ion in the $LiNO_3$–KNO_3 eutectic at 160°C. (FR)

20737 (LBL-1666, pp 325-328) LOGICAL APPROACHES TO THE SELECTION OF SEPARATION PROCESSES. Thompson, R. W.; King, C. J. May 1973.

In nuclear chemistry annual report, 1972.

20738 (ORNL-4883, pp 90-92) CHEMICAL ENGINEERING RESEARCH. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20739 (SRO-763-1) SYNERGISTIC SOLVENT EXTRACTION. Progress Report, July 1, 1972–June 30, 1973. Davis, M. W. Jr. (South Carolina Univ., Columbia. Coll. of Engineering). 24 Jul 1973. Contract AT(38-1)-763. 10p. Dep. NTIS $3.00.

The development and analysis of distribution data for the rare earths in the synergistic system kerosene–HTTA–TBP–dilute HNO_3 has continued during the past year. These data indicate that the rare earths exist as nitrate complexes of the form $M(NO_3)_2^{+1}$ in the aqueous phase at an ionic strength of 1.0. It appears probable that $M(NO_3)^{+2}$, $M(NO_3)_3$, etc., are also present with their relative abundance being a function of the nitrate concentration. The ionic strength itself does not appear to have a strong effect on the distribution coefficient. A 16 stage mini mixer settler together with all peripheral equipment, such as feed pumps, feed tanks, air motor drive, etc., has been obtained during the year. The 16 stage mini mixer settler manufactured by the Gentry Instrument Company was received very recently. Corrosion studies of 304 ELC stainless steel in solutions of nitric acid saturated with HTTA and TBP indicate a low corrosion rate of 11.3 microns/year at 25°C. The corrosion rate in two-phase systems such as will exist under process conditions was appreciably lower. (auth)

20740 EFFECTS OF THE NATURE OF THE ION EXCHANGER AND THE CONCENTRATION OF THE MICROCOMPONENTS ON THE ABSORPTION OF MICROIMPURITIES OF Cs^+ AND Sr^{2+} FROM CONCENTRATED NaCl SOLUTIONS. Tarkovskaya, I. A.; Shevchenko, S. I.; Grashchenkova, L. N. (Inst. of Physical Chemistry, Kiev). Ukr. Khim. Zh.; 39: No. 5, 520-526(May 1973). (In Russian).

The distribution coefficients for impurities of Cs and Sr between sulfate cation exchangers and oxidized coal on the one hand and NaCl solutions of different concentrations on the other hand were determined. It was found that only the Cs^+–Na^+ exchange on the sulfate cation exchanger is rigidly subject to the active mass law. It was also shown that the Me^{n+}–Na^+ exchange constants in the systems studied maintain a satisfactory constancy at any ratio of the concentration of the micro- and macrocomponents only during the Cs^+–Na^+ exchange on KU 2–4, but in the majority of cases an increase of K_{exch} is observed with increase of the concentration of the principal materials. (tr-auth)

20741 EXTRACTION OF NIOBIUM WITH THE HELP OF SOME 1-PHENYL-3-METHYL-4-ACYL-5-PYRAZOLONES. Navratil, O. (Univ., Brno). Collect. Czech. Chem. Commun.; 38: No. 5, 1333-1338(May 1973). (In German).

Investigated is the Nb(V) distribution between hydrochloric acid and solutions of 1-phenyl-3-methyl-4-acyl-5-pyrazolones in an aqueous phase containing benzene, whereby acyl stands for ethoxycarbonyl, acetyl, benzoyl, butyryl, capronyl, or capryl. Effects on the distribution ratio were determined for acidity of the aqueous phase, concentration of the reagents, and the addition of several alcohols. Niobium extraction was optimal between 7 and 9 mole HCl in the aqueous phase, it increased from ethoxycarbonyl to capryl, and it was enhanced markedly by the addition of n-butyl or isoamyl alcohol. (HBG)

20742 SEPARATION OF RARE EARTHS BY THIN-LAYER CHROMATOGRAPHY IN SYSTEMS WITH SALTING-OUT AGENTS. Babayan, Kh. S.; Varshal, G. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 5, 921-927(May 1973). (In German).

Studies were made on the separation of submicroamounts of rare earths by the TLC method in the nitrate–thiocyanate chromatographic system with a salting-out agent NH_4NO_3 as a component of the stationary phase. Conditions were found for quantitative separation of 10 to 12-component mixtures of rare earths. The method developed for analysis of submicroamounts of mixtures of rare earths provides for determination of individual rare earths in zones with the sensitivity of two orders as high (0.001 to 0.005 μg) as in the analogous process on paper. The chromatogram development time is 20 times less that in the separation of rare earth mixtures on paper. (auth)

20743 SOLVENT EXTRACTION OF MOLYBDENUM AND TUNGSTEN BY TRI-N-OCTYLAMINE AND TRI-N-OCTYLBENZYLAMMONIUM CHLORIDE FROM FLUORIDE SOLUTIONS. Tseryuta,

Yu. S.; Bagreev, V. V.; Agrinskaya, N. A.; Gushchin, N. V.; Basov, A. S.; Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 5, 946-949(May 1973). (In Russian).

The extraction of molybdenum and tungsten using tri-n-octylamine and tri-n-octylbenzylammonium chloride from fluoride solutions was studied as a function of H_2F_2, NH_4F, and extractant concentration and the solvent nature. The extraction of the metals with tri-n-octylamine from 0.5N H_2F_2, in the presence of 4 to 8M NH_4F can be used for the separation of molybdenum and tungsten. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 21870, 23886, and 23923.

Chemical and Physicochemical Properties

Refer also to abstracts 20848, 20856, 23916, 23925, 23934, 23953, 23981, 23986, 24003, 24014, 24020, 24039, 24046, 24053, and 24054.

20744 (BNL-18031) RATE PROCESSES FOR IODINE REMOVAL AND HYPOIODOUS ACID FORMATION IN THE PRESENCE OF CHEMICALLY REACTIVE CONTAINMENT SPRAYS. Dietz, R. N. (Brookhaven National Lab., Upton, N. Y.). Jul 1973. 41p. Dep. NTIS $4.25.

The chemistry of the hydrolysis of iodine was reviewed based on available literature. Hypoiodous acid is formed during hydrolysis but the question of its volatility and methods of gas phase measurement have not been resolved. Based on a calculated Henry's Law constant and the kinetics of the reduction of iodine hydrolysis products with hydrazine, rates of mass transfer to liquid spray drops were calculated for several spray conditions at the peak LOCA temperature. The concentration of HOI relative to the total dissolved iodine at the interface decreases with decreasing pH and increasing iodide concentration. A detailed review of the kinetics of iodine hydrolysis indicates that the negative ion specie, I_2OH^-, may be the active substance in solution. (auth)

20745 (CONF-730820-1) POSSIBILITY OF APPLYING MESON SPECTROSCOPY TO THE STUDY OF SOLUTION CHEMISTRY. Lietzke, M. H.; Stoughton, R. W. (Oak Ridge National Lab., Tenn.). 1973. 4p. Dep. NTIS $3.00.

From LAMPF users meeting; Los Alamos, New Mexico, USA (27 Aug 1973).

The possibility of using meson spectroscopy for studying aqueous electrolyte solutions and solutions of non-aqueous solvents was explored. The need for systematic studies is discussed. (DHM)

20746 (RD/B/N-2547) ROLE OF CONDUCTION BAND ELECTRONS IN THE CHEMICAL REACTIONS OF LIQUID SODIUM. Whittingham, A. C. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Feb 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The chemistry of liquid sodium is closely associated with the availability for reaction of the valence electrons which constitute the liquid metal "conduction band". The energies of the "conduction band" electrons may be modified by the addition of various solutes which either add electrons to or subtract electrons from the conduction band, thereby influencing the availability of these electrons for reaction with a particular reactant. A brief account is given of the theories of electrons in liquid metals and of the structure of liquid metals. Progress in understanding electrons in liquid metals has been made by keeping close contact with the "free electron" and "band" theories of solid metals. The concepts of conduction band, density of states, and Fermi energy are explained and it is shown that, in the case of liquid sodium, the "free electron" approximation is valid. The relationship between the Fermi energy and the chemical potential of sodium, which will be modified by the addition of various solutes, is given. (auth)

20747 POSITRON ANNIHILATION AND ITS ROLE IN CHEMISTRY. Vertes, A.; Levay, B. (Eoetvos Lorand Tudomanyegyetem, Budapest). Kem. Kozlem.; 37: No. 2, 221-241(1972). (In Hungarian).

The application of the interaction between positrons and matter to chemical and structural studies is described. A short survey of positronium formation and actual measurement methods is given. The application possibilities of the method, especially the parameters which can be measured in liquid, gas and solid phases, have been illustrated on selected examples taken from the literature. (INIS)

Isotope Effects

Refer also to abstracts 20843 and 24009.

20748 (CEA-N-1618) STIMULATED EMISSION FROM MIXTURES OF ISOTOPIC SPECIES OF CO_2. Capitini, R.; Ceccaldi, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1973. 39p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

Stimulated emission from a single isotopic species in a laser containing a $^{12}CO_2-^{13}CO_2$ mixture has already been described. In the present experiment, the working conditions have been modified. The conclusions are as follows: stimulated emission from only $^{12}CO_2$ is obtained for $^{13}C/^{12}C+^{13}C$ rations between 0.01 and 0.34; stimulated emission from $^{13}CO_2$ alone is obtained when this ratio has a value of above 0.40; between 0.34 and 0.40, simultaneous emission (on a millisecond scale) is observed from the two species. In the latter case, it is shown that the electrodes play an important role. In certain cases, time modulated emissions with pseudo-periods of about 15 minutes are observed, the emissions from $^{12}CO_2$ and $^{13}CO_2$ being out of phase. Analogous phenomena are observed with ^{18}O enriched mixtures. Their interpretations are however less straight forward as a result of equilibria between $C^{16}O_2$, $^{12}C^{16}O^{18}O$, and $^{12}C^{18}O_2$. The stimulated emission at 1070 cm^{-1} observed by Wieder and MacCurdy was not detected, even in mixtures containing up to 30% of $C^{18}O_2$. New laser lines around 945 cm^{-1} are tentatively attributed to $^{12}C^{16}O^{18}O$. Two unstable emissions near 972 cm^{-1} may be attributed to very close $C^{18}O_2$ and $C^{16}O^{18}O$ levels linked by energy transfer. Chemical analysis of the mixtures during excitation revealed species produced by the decomposition of CO_2. Such species must be considered in the complete interpretation of the phenomena. (FR)

20749 KINETIC ISOTOPIC EFFECT IN HYDROGEN EXCHANGE REACTIONS OF CH = ACIDS WITH DMSO CATALYZED BY $CH_3S(O)CH_2K$ AND $(CH_3)_3COK$. Romansky, I. A.; Shapiro, I. O.; Shatensteyn, A. I. (Moscow Inst. of Physical Chemistry). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 9: No. 4, 951(Dec 1972). (In Russian).

Results of measurements of the kinetic isotopic effect (KIE) in reactions of protofilic isotopic hydrogen exchange of the CH bond of the methyl group of toluene and the aromatic cycle of 1,3,5-trimethoxybenzene with dimethylsulfoxide (DMSO) catalyzed by $CH_3S(O)CH_2K$ or $(CH_3)_3COK$, are tabulated. Depending on the catalyst used, various MG values were obtained: in the case of $CH_3S(O)CH_2K$, K_D/K_T = 2.8 to 3.0, in the case of $(CH_3)_3COK$, K_D/K_T = 1.0 to 1.2. The mechanism of the exchange reactions in the system of DMSO–$(CH_3)_3COK$ has been reported previously. From the KIE values obtained, a conclusion is drawn that reactions catalyzed by $CH_3S(O)CH_2K$ proceed by a two-step scheme, similar to that reported for systems of KNH_2-NH_3 and $C_6H_{11}NHLi(C_8)-C_6H_{11}NH_2$, in which the rate controlling step is that of ionization of CH = acid. (auth)

20750 KINETICS OF THE REACTIONS OF CYCLOPROPANE DERIVATIVES. IV. Kinetic Isotope Effect in the Isomerization of Cyclopropylamine. Luckraft, D. A.; Robinson, P. J. (Univ. of Manchester, Eng.). Int. J. Chem. Kinet.; 5: No. 3, 329-331 (1973).

The high-pressure isotopic rate ratio k_H/k_D for isomerization of cyclopropylamine and deuterated cyclopropylamine is 1.06 at 649 to 678°K, supporting a mechanism that does not involve migration of hydrogen from the amine group in the rate-determining step. (auth)

20751 ISOTOPE EFFECTS OF THE VIRIAL-COEFFICIENTS OF HYDROCARBONS. Gainar, I.; Schaefer, K.; Schmeiser, B.; Schramm, B.; Strein, K. (Univ., Heidelberg). Ber. Bunsenges, Phys. Chem.; 77: No. 5, 372-376(1973). (In German).

Experimental data on the temperature dependence of the second virial coefficient isotopic effect are presented for the following systems: ethane and deuteroethane-d_6 in the temperature range from 205°K to 520°K, ethylene and deuteroethylene-d_4 in the temperature range from 210°K to 510°K, and neopentane and deuteroneopentane with one, two, three or four methyl groups deuterated in the temperature range from 300°K to 510°K. The isotopic effect can be interpreted by assuming that the virial coefficients of isotopic gases can be calculated with the same Lennard–Jones (n-6) potential, that only the potential parameters have to be changed between the isotopic species, and that the difference between the potential parameters can be evaluated from the difference in size and polarizability of isotopic molecules. (GE)

20752 ISOTOPE EFFECTS IN THE FORMATION OF H^- AND D^- BY DISSOCIATIVE ATTACHMENT OF H_2S, HDS, D_2S, AND H_2O, HDO, D_2O. Tronc, M.; Goursaud, S.; Azria, R.; Fiquet-Fayard, F. (Paris Univ., Orsay, France). J. Phys. (Paris); 34: No. 5, 381-388(May 1973). (In French).

The cross sections ratios for H^- and D^- formation in H_2S, D_2S, H_2O, and D_2O were measured with a mass spectrometer. The following values were obtained: $\sigma(H^-/H_2S)\ \sigma(D^-/D_2S) = 1.33$, $\sigma(H^-/H_2O)\ \sigma(D^-/D_2O) = 1.25$. This isotope effect is a consequence of the small mean self-ionization width of the negative resonant ion state. A new isotope effect was observed: $\sigma(H^-/HDX)\ \sigma(D^-/HDX) = 2.45$ in H_2S, 3.55 in H_2O. This effect is explained by the HDX^- negative ion dissociation on a saddle-point potential surface. (FR)

20753 PHOTOLYSIS OF 2-(p-METHOXYPHENOXY)-1-PHENYLETHANOL IN THE PRESENCE OF BENZOPHENONE. Determination of the Rate Constant and the Deuterium Isotope Effect. Saburi, Y.; Yoshimoto, T.; Minami, K. (Tokyo Univ.). Nippon Kagaku Kaishi; 1973: No. 4, 864-867(Apr 1973). (In Japanese).

It was previously reported that acetophenone was produced in good yield from the photolysis of 2-phenoxy-1-phenylethanol(PPE) with benzophenone, but, in the case of 2-(p-methoxyphenoxy)-1-phenylethanol(MPPE) with benzophenone, the preferential product was benzaldehyde. In order to elucidate the mechanism of benzaldehyde formation, the rate constant k_r was determined and the deuterium isotope effect was investigated. In the case of benzophenone–PPE, the value of k_r was $3.6 \times 10^6\ l \cdot mol^{-1} \cdot sec^{-1}$ (the isotope effect = conversion of PPE-d/conversion of PPE, 0.50). On the other hand, in the case of benzophenone-MPPE, a remarkably large k_r value was obtained (1.4×10^8) and the isotope effect (conversion of MPPE-d/conversion of MPPE) was scarcely observed (1.1). (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 20803, 20835, 21125, and 23984.

20754 (FRNC-TH-367) STUDY OF H_2-D_2 ISOTOPIC EXCHANGE CATALYZED BY NICKEL AND ZINC OXIDES. Richard, S. (Lyon Univ. (France)). 1972. 131p. (In French). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis.

Isotopic H_2-D_2 exchange in contact with nickel and zinc oxides was studied. These oxides have very different properties (nickel oxide is an electrical insulator and zinc oxide is an n type semiconductor). Nickel oxide is not very active at −196°C in the H_2-D_2 exchange reaction effected with freshly prepared catalysts. On the other hand, the solid becomes very active at −196°C after a reheating at 25°C in the presence of hydrogen. This phenomenon is explained by the absorption at 25°C of hydrogen species having a participation in the reaction at −196°C. Studies of the activity of partially reduced nickel oxide at −78°C demonstrated that exchange on the oxide itself occurs at this temperature. H_2-D_2 isotopic exchange effected in contact with zinc oxide at 0°C presents similar characteristics to that carried out with nickel oxide at −196°C. The exchange takes place through a Boreskov–Vassilevitch or Rideal mechanism. A fraction of the hydrogen is absorbed in the form of atoms, the reaction necessitating the presence of two active neighboring sites in the solid. In addition, studies of paramagnetic defects in zinc oxide were made but no correlation was found between the catalytic activity of zinc oxide at 0° and the number of paramagnetic defects contained. (FR)

20755 CARBON-13 THE GROWING ORGANIC ISOTOPE. Eck, C. F. (Monsanto Research Corp., Miamisburg, OH). Res./Develop.; 24: No. 8, 32-38(Aug 1973).

A review is presented that contains a brief history of ^{13}C, an overview of its separation, production, prices, distribution, usage problems, and some current uses. (DHM)

20756 COMPLETE ISOTOPE SEPARATION IN PHOTOCHEMICAL PROCESSES. Vasov, Yu. G. At. Energ. (USSR); 33: No. 4, 842(Oct 1972). (In Russian).

This paper was summarized as paper No. 613/6722 with full copy held by TIC.

The different aspects of isotope separation in single-stage photochemical processes are considered and the effect of monochromatic light on binary isotope mixtures is discussed. The application of laser light is presently difficult since the wavelengths of laser generators do not coincide with the absorption bands of isotopes. The difficulties can be avoided by using lasers with continuously adjustable frequencies corresponding to ultraviolet light in vacuum so that the light quanta energy is sufficient to break the molecular bonds in the irradiated material. This problem has not yet been solved technically. A more general method is to cut out specific ultraviolet lines by means of interference filters. The dissociation energies of the H_2 and D_2 isotopes of gaseous hydrogen are 4.780 and 4.823 eV, respectively. Thus, for total separation their mixture should be irradiated together with a substance that reacts chemically with atoms or excited molecules of hydrogen. Monochromatic light with a wavelength 2593.7 Å is used for irradiation. The emission band width should not exceed 23.1 Å in the 2570.6 to 2593.7 Å interval. For oxygen isotope molecules O_2^{16} and O_2^{18} with dissociation energies 5.0636 and 5.0692 eV, respectively, the band width of emission resonantly absorbed by O_2^{16} should not exceed 0.0056 eV. Total separation can be most easily achieved with isotope molecules whose dissociation or excitation energies differ considerably (e.g., the isotope mixtures H_2-D_2, NH_3-ND_3, etc.). (DHM)

20757 SYNTHESIS OF (1R)-[2-^{18}O]-α-FENCHOCAMPHORONEQUINONE. Specific Labeling of One Carbonyl Group in a Norbornane-2,3-dione. Kokke, W. C. M. C. (Leiden Univ.). J. Org. Chem.; 38: No. 17, 2989-2994(24 Aug 1973).

A method was devised for the preparation of a norbornane-2,3-dione with one of the carbonyl groups enriched specifically in ^{18}O, viz., oxidation of a labeled ketone with selenium dioxide in acetic anhydride. This method was applied to the oxidation of labeled, optically active α-fenchocamphorone giving specifically labeled α-fenchocamphoronequinone. This diketone, whose optical activity is due only to ^{18}O substitution, showed a small but measurable effect in the CD of both low intensity absorption bands in the region of 250-520 nm. (auth)

Feed Materials Processing

Refer also to abstracts 20863 and 20882.

20758 (AAEC/LIB/Bib-371) URANIUM HEXAFLUORIDE. A Bibliography. McDonald, C. J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1972. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

Sixty-four references deal mainly with environmental aspects, effluents discharge, and safety handling at production plants. Arrangement is chronological by year, covering 1948-1972, and alphabetical by author within each year. Reference is made to abstracts for citations in NSA. (AT)

20759 (CEA-CONF-2284) INTERNATIONAL CONTRACTS AND AGREEMENTS CONCERNING THE PROVISIONS OF ORE, CONCENTRATES, AND URANIUM HEXAFLUORIDE. Blanc, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1973. 7p. (In French). (CONF-730341-8). Dep. NTIS (U. S. Sales Only) $3.00.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

The essential characteristics of these agreements are more significant in the domain of economics than in the legal domain. Other than agreements concerning prospection for ores, the most important aspects concern uranium hexafluoride intended for enrichment plants and ultimately for nuclear plant fuels. (FR)

20760 (CONF-721091-, pp P22.p1-P22.p4) USE OF ISOTOPES IN URANIUM EXTRACTION RESEARCH. Faure, A.; James, H. E. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

A number of examples are given of the use of radioisotopes in the uranium research program of the Extraction Metallurgy Division of the Atomic Energy Board to illustrate that nuclear techniques can be safely and successfully applied in the laboratory, on pilot plants and on industrial-scale plants. The examples given fall into two main categories, i.e., tracer experiments involving the addition of radioisotopes to process streams and the development of on-line analyzers incorporating sealed radioisotope sources. (auth)

20761 (K-1775) REMOVAL OF IMPURITIES FROM URANIUM HEXAFLUORIDE BY SELECTIVE SORPTION TECHNIQUES: THIRD PROGRESS SUMMARY REPORT. Stephenson, M. J.; Pashley, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn). 29 Aug 1973. Contract W-7405-eng-26. 45p. Dep. NTIS $4.00.

An experimental program is being conducted at the Oak Ridge Gaseous Diffusion Plant to evaluate the effectiveness of various solid sorbent materials for selectively removing certain volatile impurities from uranium hexafluoride. The basic testing procedure involves preparing a uranium hexafluoride feed containing some trace quantity of volatile impurity and subsequently passing this feed through a fixed bed of the test sorbent maintained at a selected temperature, and then obtaining representative samples of the contaminated uranium hexafluoride stream entering and

leaving the sorption trap at various time intervals during the course of the run. Sorption tests using uranium hexafluoride-impurity fluoride gas mixtures have demonstrated the feasibility of using the selective sorption technique for the effective and economic purification of uranium. Recent tests showed that at 250°F aluminum fluoride, cryolite, sodium fluosilicate, lithium fluoride, and nickel fluoride selectively sorb niobium pentafluoride and titanium tetrafluoride, as well as magnesium fluoride had in earlier tests, and that the 1 ppM specification limit for niobium can be met using one or more of these new sorbents. It was also found that at 180° to 250°F, cryolite and sodium fluosilicate selectively sorb ruthenium fluoride significantly better than sodium fluoride had at 650°F and that the 1 ppM specification limit for ruthenium can also be achieved. Tests showed that the physical structure of the sorbent pellet plays a decisive role in determining the sorption qualities of a particular material, and consequently, the methods of pellet preparation, drying, sintering, and pretreatment are critical to the analysis and evaluation of new sorbent materials. (auth)

20762 ORE SEPARATION PROCESS. Gammill, A. M.; Runion, T. C.; Householder, W. R. (to Nuclear Fuel Services Inc.). U. S. Patent 3,740,199. 19 Jun 1973. Filed date 7 Apr 1971. 6p.

A process is reported for the recovery of niobium, tantalum, molybdenum, uranium, the rare earths, and thorium from euxenite ore using thermite reduction to convert the ore to a product in which the uranium and rare earths in the slag can be readily leached from the slag with mineral acids. The other product recovered is a metal regulus containing a commercially usable ferroniobium or ferrotantalum product. (auth)

20763 DESCRIPTION OF A CONVERSION FACILITY FOR PLUTONIUM NITRATE. Kuhn, K. D.; Koch, K. H. (Alpha Chemie und Metallurgie, GmbH, Hanau, Ger.). Kerntechnik; 15: No. 6, 257-263(1973). (In German and English).

The plutonium recovered in the reprocessing of spent nuclear fuel is obtained in the form of nitrate which must then be converted to PuO_2. A conversion facility is described based on Pu(IV) oxalate precipitation. The materials and apparatus must be selected following special criteria such as prevention of contamination and criticality accidents, ease of maintenance and repairs, and corrosion resistance. The operating experience so far has been satisfactory. (auth)

Radiation Chemistry

Refer also to abstracts 20753, 21462, 21490, 21499, 21506, 22082, 24021, and 24022.

20764 (COO-3029-9) STUDY OF RARE EARTH ZEOLITES. Iton, L.; Nicula, A.; Turkevich, J. (Princeton Univ., N. J.). 1972. 3p. Dep. NTIS $3.00.

An EPR spectral study is reported of all available rare earth Y zeolites and some mordenites in the hydrated, dehydrated at 550°C, hydrogen reduced, and γ-irradiated states at 77°K. (DHM)

20765 (LBL-1666, pp 302-303) PHOTOLYSIS OF AQUEOUS N-ACETYLALANINE AT 2288A. Jayko, M. E.; Sokol, H. A.; Garrison, W. M. May 1973.

In nuclear chemistry annual report, 1972.

20766 (RRL-3238-446) QUARTERLY REPORT, APRIL 1-JUNE 30, 1973. (Mellon Inst. of Science, Pittsburgh, PA. Radiation Research Labs.). 20 Jul 1973. Contract AT(11-1)-3238. 18p. Dep. NTIS $3.00.

Abstracts of reports issued in the period April 1 to June 30, 1973 are presented. Other investigations in progress include: ESR study of the reaction of OH radicals with NCO^-; ^{13}C splittings in some carboxylated hydroxycyclohexadienyl radicals; ESR spectra of radicals produced from some 4-nitro- or 4-bromo-2,3-dioxopyrrolidines; radiation chemical studies on aqueous solutions of α-bromotetronic acid; reactions of the radiolytically generated hydroxycyclohexadienyl radical in aqueous benzene systems; and ion neutralization rates in pulse irradiated gases. (DHM)

20767 (RRL-3238-453) ESR-RADIATION CHEMICAL STUDIES OF HALOURACILS AND NITROURACILS. Neta, P. (Mellon Inst. of Science, Pittsburgh, Pa. Radiation Research Labs.). 7 Aug 1973. Contract AT(11-1)-3238. 12p. (CONF-730921-1). Dep. NTIS $3.00.

From 5th L. H. Gray memorial conference on fast processes in radiation chemistry and biology; Brighton, UK (10 Sep 1973).

The application of electron spin resonance spectroscopy to the study of the radiation chemistry of 5-halouracils and 5-nitrouracils in aqueous solutions is described. Results obtained by the steady-state in situ radiolysis-ESR technique are discussed along with related work utilizing other techniques. The chemical reactions that take place in these systems are summarized. Hydroxyl radicals add partially to the 5 position and cause a rapid oxidative dehalogenation or denitration. Addition to the 6 position does not result in immediate elimination of halide, although slow subsequent processes were found to yield nitrite from the nitro compounds. The anion radicals produced by reaction of e^-_{aq} are stable in the case of the nitrouracils. However, with the halogen compounds, these radicals undergo further rapid reactions, either eliminating X^- (with bromo- and chlorouracil) or protonating (fluoro- and chlorouracil). (auth)

20768 REACTIONS OF IRON(II) AND TITANIUM(III) WITH ORGANIC RADICALS. Behar, D.; Samuni, A.; Fessenden, R. W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 17, 2055-2059(16 Aug 1973).

In situ radiolysis-ESR experiments on acid solutions (0.8N H_2SO_4) of malonic acid established that the main reaction of OH is abstraction of a CH hydrogen to produce $\dot{C}H(CO_2H)_2$ but that approximately 10% of the reaction leads to the radical $\dot{C}H_2CO_2H$ by decarboxylation. (In basic solution, decarboxylation of $CH_2(CO_2^-)_2$ by OH was not observed and, at most, can account for 0.5% of the total reaction.) The fact that the main reaction occurs by abstraction is in apparent disagreement with previous results of rapid-mixing experiments in which only the ESR spectrum of $\dot{C}H_2CO_2H$ was found. Radiolysis experiments in which Ti(III) was added to the solution before irradiation showed that $\dot{C}H(CO_2H)_2$ reacts with the metal ion while, at the concentrations used, $\dot{C}H_2CO_2H$ does not. This extra radical destruction reaction can explain, in part at least, the absence of detectable signals of the former radical in the rapid-mixing experiments. Radiation chemical experiments were carried out to further investigate the reaction of organic radicals with the reduced metal ions Ti(III) and Fe(II). Measurement of the yields of Ti(VI) and Fe(III) in solutions containing various organic solutes showed that while a number of types of radicals such as those derived from alcohols and carboxylic acids as well as alkyl radicals can oxidize Ti(III) only those of type $RR'\dot{C}CO_2H$ appear to be able to oxidize Fe(II). Methane was confirmed as the organic product of the reaction $\dot{C}H_3$ with Ti(III). (auth)

20769 DISSOLUTION METHOD FOR FREE RADICAL SCAVENGING IN THE RADIOLYSIS OF SOLIDS. Tilquin, B.; Allaert, J.; Dautricourt, A.; Mauer, D.; Claes, P. (Univ., Louvain, Belgium). Int. J. Radiat. Phys. Chem.; 5: No. 4, 343-349(Jul 1973).

The influence of several parameters on radical scavenging during the dissolution of irradiated solids at low temperature was investigated. Radical decay during the warming of irradiated solid n-undecane from 90°K was studied by electron spin resonance. The results show that decay does not occur at temperatures lower than 160°K in the case of samples annealed before irradiation. On the other hand, radicals are scavenged when the solid, irradiated at 77°K, is dissolved at 160°K in isopentane containing oxygen or olefins. Such scavenging lowers the dimer G-value from 0.55 to 0.31. (auth)

20770 γ-RADIOLYSIS OF 4-NITROPHENOL IN AQUEOUS HBr SOLUTION. Schulte-Frohlinde, D.; Reutebuch, G.; von Sonntag, C. (Max-Planck Institut fuer Kohlenforschung, Muelheim, Ger.). Int. J. Radiat. Phys. Chem.; 5: No. 4, 331-342(Jul 1973).

In the γ-radiolysis of aqueous solutions of 4-nitrophenol, 4-nitropyrocatechol (G = 2.95) and 4-aminophenol (G = 1.1) are formed. The addition of HBr in concentrations up to 0.5 mol dm^{-3} HBr has a protective effect. The G-value for the disappearance of 4-nitrophenol is strongly reduced. At 0.5 mole dm^{-3} HBr G(4-nitro-pyrocatechol) is lowered to 0.1, and G(4-aminophenol) to 0.15. This effect is explained by assuming that the OH radicals react with Br^- giving Br· atoms which further react to Br_2^-. An explanation of this protective effect is based on the assumption that Br· or Br_2^- may either dehydrogenate the 4-nitrophenol-H atom adduct, or that, alternatively, the 4-nitrophenol-Br atom adduct may react with the H atom adduct resulting in the formation of HBr and two molecules of 4-nitrophenol. With Br concentrations above 0.5 mol dm^{-3} the G value for the disappearance of the substrate increases again owing to loss through bromination. In a 9 mole dm^{-3} HBr solution 2-bromo-4-nitrophenol (G = 4.9) and 4-aminophenol (G = 1.37) are formed. Some possible mechanisms of bromination are discussed. A satisfactory material balance was obtained for all HBr concentrations investigated. (auth)

20771 GAMMA RADIOLYSIS OF SOLID SUCCINIC ACID. Bartoníček, B. (Ustav Jaderneho Vyzkumu, Rez, Czechoslovakia). Int. J. Radiat. Phys. Chem.; 5: No. 4, 361-369(Jul 1973).

Radiation decomposition of solid succinic acid by gamma radia-

tion was examined. Carbon dioxide, succinic semialdehyde, propionic acid, and water were formed as the major decomposition products. The formation of a polymer, hydroxyacids, CO, and H_2 was also proved. The investigation of optical absorption spectra of irradiated monocrystals of succinic acid showed the presence of two radicals; one of them with an absorption maximum at 320 nm can be assigned to an acyl radical, and the other with an absorption maximum at 305 nm to a stable HOOC $CH_2\dot{C}H$ COOH radical. On the basis of these results and the results of ESR studies the possible reactions of primary species are discussed and a mechanism of the radiolysis of succinic acid is suggested. (auth)

20772 ONSAGER'S CHARGE RECOMBINATION THEORY APPLIED TO LIQUID ALKANES. Freeman, G. R.; Dodelet, J. P. (Univ. of Alberta, Edmonton). Int. J. Radiat. Phys. Chem.; 5: No. 4, 371-374(Jul 1973).

The theory for the effect of applied electric field strength on radiolytic free ion yields in liquids is discussed with reference to n-hexane and neopentane. The use of Onsager's escape probability function averaged over three-dimensional space leads to essentially the same results as does the use of the function averaged over two-dimensional space, although the former is formally more correct. Results from the two equations for y = 120 Å differ by only 3 percent at an applied field of 100 kV/cm, and by less at lower fields. However, serious errors are introduced when an effective value of the secondary electron range is used instead of a suitable distribution of ranges in the calculations. Use of a single effective value of the range leads to an underestimate of the total ionization yield. Contrary to a suggestion recently published (Terlecki et al., Int. J. Radiat. Phys. Chem.; 4: 469 (1972)), total ionization yields in liquid alkanes appear to be similar to those in the gas phase. (auth)

20773 PROPERTIES OF Sm(II), Eu(II), Tm(II), Yb(II), AND Pr(IV) IONS IN AQUEOUS SOLUTIONS FROM PULSE RADIOLYSIS. Pikaev, A. K.; Sibirskaya, G. K.; Spitsyn, V. I. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 5, 1154-1157 (11 Apr 1973). (In Russian).

Pulsed radiolysis was utilized as a means of overcoming the usual difficulty in studying the properties of divalent Sm, Eu, Tm, Yb, and tetravalent Pr. A linear accelerator provided 5 MeV electrons in 2.3 μsec pulses which converted the trivalent Sm, Eu, Tm, and Yb to Me(II) in aqueous solutions of their perchlorates ($Me(ClO_4)_3$). Optical spectra were recorded from 0.05 M solutions of the rare earth elements. Rate constants for a number of reactions involving the divalent Eu, Yb, Sm, Tm, and the trivalent Pr are given. (KSW)

20774 HYDROGEN FORMATION IN γ-RADIOLYSIS OF N,N-DIMETHYLFORMAMIDE (DMF). Kroh, J.; Burzynska, E. (Technical Univ., Lodz, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 4, 289-291(May 1973).

The γ-radiolysis and uv photolysis at 2537 Å of N,N-dimethylformamide was investigated. The yields of hydrogen $G(H_2) = 1.45$ and $\Phi(H_2) = 7.9 \times 10^{-3}$ were determined. It is concluded that hydrogen is formed during radiolysis mainly via ionic and excited species. The influence of ionic scavengers was studied. (auth)

20775 RADIOLYSIS OF MIXTURES OF CARBON MONOXIDE AND HYDROGEN. Beattie, W. H. (Los Alamos Scientific Lab., NM). Int. J. Chem. Kinet.; 5: No. 3, 333-343(1973).

The self-radiolysis of mixtures of CO and tritium ($^3H_2$) was studied at pressures of 0.25 to 1.0 atmospheres, temperatures of −198° to +100°C, and in the presence of added H_2O or CO_2. The products of decomposition are CO_2, ^3H_2O, C^3H_4, $C_2{}^3H_4$, and a white polymer believed to be polyformaldehyde. Initial rates and G values were measured and compared with rates of ion pair formation. The rates of formation of both CO_2 and C^3H_4 are independent of temperature and proportional to the energy absorbed in the $^3H_2$. (auth)

20776 RADIATION CHEMICAL STUDIES OF PROTEIN REACTIONS: EFFECT OF ALKALINE-EARTH METALS ON OPTICAL ROTATION. Nisizawa, M. (Defense Academy, Yokosuka, Japan). J. Macromol. Sci., Part A; 7: No. 3, 765-781(1973).

Magnesium chloride, calcium chloride, strontium nitrate, and barium chloride were found to protect against changes in the internal relationships of the atoms in the protein molecule from γ radiation damage. The optical rotation behavior closely resembles that of amino acids by showing a similar dependence on the concentration. (auth)

20777 RADIATION-INDUCED COPOLYMERIZATION OF TETRAFLUOROETHYLENE AND PROPYLENE. 2. Copolymerization in Solution. Kojima, G.; Tabata, Y. (Japan Atomic Energy Research Inst., Takasaki). J. Macromol. Sci., Part A; 7: No. 3, 783-793(1973).

Copolymerization of tetrafluoroethylene and propylene in chlorofluorohydrocarbon solvents was carried out below room temperature with γ-rays from a ^{60}Co source. A remarkable rate-accelerating effect was observed in these solution systems, although the activation energies and the compositions of copolymers were almost the same as those in bulk system. The most effective solvent was found to be trichlorotrifluoroethane. Kinetic results of the copolymerization in trichlorotrifluoroethane solution system revealed the role of solvent to be complicated, with the possibility of affecting almost all reaction steps of the polymerization. (auth)

20778 RADIOLYSIS OF CYCLOHEXANE-HEXAMETHYLBENZENE MIXTURES. Roder, M. (Central Research Inst. of Physics, Budapest). Isotoptechnika; 16: No. 6, 291-296(Jun 1973). (In Hungarian).

The protective effect of hexamethylbenzene during the γ irradiation of cyclohexane is caused mainly by the transmission of positively charged particles. (auth)

20779 EFFECT OF IONIZING RADIATION ON PROTEINS IN WATER SOLUTION. Schuessler, H. (Univ., Erlangen, Ger.). Biophysik; 9: No. 4, 315-324(1973). (In German).

A review is presented that shows the development in radiation research on proteins from the early work of Fricke and Dale up to the modern radiation biology. The radiation-induced changes in the conformation of the molecules were made evident by using modern techniques in protein chemistry. New results in radiation chemistry try to explain these changes by the reactions of the primary products of water radiolysis with the proteins. The rate constants for the reaction of the water radicals with amino acids and proteins can be measured by pulse radiolysis. It was shown by experiments with scavengers that the inactivation process is mainly due to the reaction of OH radicals and not of the solvated electrons though they cause the destruction of cystine. (auth)

20780 COMPARISON OF THE COMPOSITION OF THE PRODUCTS OF THE γ-RADIOLYSIS OF PROPANOLS IN THE LIQUID AND SOLID STATES (−78° AND −196°C). Afanas'ev, A. M.; Kalyazin, E. P. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 42-43(1973).

Translated from Khim. Vys. Energy.; 7: No. 1, 51-53(1973).

The radiation yields determined for the radiolysis products of n-propanol and isopropanol in the solid and liquid state are given. The greatest difference in yields is observed for simple ethers and C_3 hydrocarbons. The yields of methyl isopropyl ether in the radiolysis of isopropanol and of ethyl propyl ether in the case of n-propanol is about 13 and 4.5 times greater, respectively, at −78°C than at −196°C. It was also found that the total yield of products, which require for their formation the breaking of C−C bonds, is lower in solid propanol than in the liquid. The overall yield of decomposition of n-propanol in both states is lower than the yield of decomposition of isopropanol. (DHM)

20781 PHOTOCHEMISTRY OF FREE RADICALS. Radicals of Monocarboxylic Acids. Chervonenko, V. S.; Roginskii, V. A. (Physical Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 44-46(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 53-56(1973).

Photochemical reactions of $R\dot{C}HCOOH$ radicals (R = H, CH_3, C_2H_5, C_3H_7) in acetic, propionic, butyric, and valeric acids were studied by means of ESR, low-temperature spectroscopy, and gas chromatography. The radicals were formed after γ irradiation (^{60}Co) at 77°K with doses up to 4 Mrad followed by heating to 196°K. The action of light on unirradiated samples did not lead to the formation of radicals and gaseous products. Optical absorption spectra and quantum yields were measured in γ-irradiated (at 77°K) 10%-transmitting solutions of acetic acid in 10 M KOH and 10 M H_2SO_4 after the radicals to be investigated have been produced by means of illumination at $\lambda \geq 300$ nm, followed by heating to 140 ± 10°K. (DHM)

20782 REACTION OF ATOMIC HYDROGEN WITH AMINO ACID COMPLEXES OF Co(III). Shagisultanova, G. A.; Tikhonov, A. S.; Grinkevich, V. A. (Belorussian State Univ., Minsk). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 49-50(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 57-59(1973).

A study was made to establish the mechanism of the reaction of H atoms with complexes of the composition $[Co(NH_2CH_2COO)_3]$, $[Co(gly)_3]$; $[Co(CH_3CH(NH_2)(COO)_3]$, $[Co(alan)_3]$; and $[Co((CH_2)_2-CHCH(NH_2)COO)_3]$, $[Co(valin)_3]$. Deaerated solutions of the complexes ($C = 1.10^{-3}$ M, solvent 0.8 N H_2SO_4) were treated with γ radiation from ^{137}Cs. Under these conditions the hydrated electron formed by the action of the radiation on the water are converted to H atoms which reacts with the compounds studied. Data show that there is an increase in the rate constants in the series $[Co(valin)_3] > [Co(alan)_3] > [Co(gly)_3]$. The study provides

experimental proof of the mechanism for the reduction of the metal complex with hydrogen atoms. (DHM)

20783 EFFECT OF ADSORPTION OF N_2O, O_2, AND CO ON THE ESR SPECTRUM OF IRRADIATED γ-ALUMINA. Kolbanovskii, Yu. A.; Chernysheva, A. S. (Inst. of Petrochemical Synthesis, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 56-57(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 65-66(1973).

The ESR spectra of γ-Al_2O_3, irradiated at 77°K by ^{60}Co γ-rays, is a broad singlet (~44 Oe) with g = 2.0072 ± 0.0005. When the specimen is heated to 300°K, as a result of thermal annealing the signal intensity decreases by approximately 1.5 times. At 77°K, no changes in the form and intensity of the signal are observed, either for adsorption of the gases on a surface preirradiated in vacuum or for irradiation after adsorption, since at 77°K the adsorbed gases do not react with the paramagnetic centers formed during irradiation of the catalyst. Heating the irradiated system γ-Al_2O_3–N_2O to 300°K leads to the same reduction in the signal intensity as that observed when γ-Al_2O_3 itself, irradiated in vacuum at 77°K, is heated to 300°K. When the system γ-Al_2O_3–CO, irradiated at 77°K, is heated to 300°K the signal changes. It acquires a hyperfine structure, consisting of six lines with splitting constant ~27.5 Oe. The g-factor of the signal does not change. A similar signal appears when this system is irradiated at 300°K and is retained for approximately a month. (DHM)

20784 RADIOLYSIS OF RUBBERS IN THE PRESENCE OF ADMIXTURES OF A STABLE FREE RADICAL. Fedoseeva, T. S.; Kamzolova, Z. A.; Kuz'minskii, A. S.; Rozantsev, E. G. (Scientific-Research Inst. of the Rubber Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 58-60(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 67-69(1973).

The γ-radiolysis of 1,4-cis-polybutadiene in the presence of admixtures of 2,2,6,6-tetramethyl-4-oxopiperidine-1-oxyl radical was studied in order to obtain information on the effect of admixtures of different structures on the crosslinking and destruction of rubbers. Results show that admixtures of the stable free radical in a wide range of concentrations inhibit the formation of crosslinks in the polymer; the inhibiting effect increases with radical concentration when irradiation is performed at room temperature but is virtually independent of the radical concentration if irradiation is performed at 77°K. (DHM)

20785 EFFECT OF DOSE RATE ON THE STABILIZATION OF PARAMAGNETIC PARTICLES DURING THE LOW TEMPERATURE RADIOLYSIS OF ALKYLAMINES. Telkova, T. N.; Revina, A. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 63-65(1973).

Translated from Khim. Vys. Energy.; 7: No. 1, 71-73(1973).

ESR methods were used to investigate the effect of dose rate on the yield and kinetics of intermediate product formation from the γ and electron pulse radiolysis of monobutylamine (MBA), dibutylamine (DBA), and tributylamine (TBA) in the solid phase at 77°K. The ESR spectra show that for the irradiation of MBA an increase in dose rate leads to a change in the relative yield of paramagnetic particles (PMP). These changes are not evident in the weakly resolved spectra of DBA and TBA. Curves for the accumulation of PMP's in MBA at the different dose rates show that for the γ-irradiated samples the linear portions of the curves extend to 4×10^{20} eV/g, but at the high dose rate, deviation from linearity begins at 1.8×10^{20} eV/g. For DBA and TBA an increase in dose rate leads to a reduction in the radiation yield of PMP's, but the accumulation curves are linear to 4×10^{20} eV/g. (DHM)

20786 RADICALS IN γ-IRRADIATED CLATHRATES FORMED BY NITROPARAFFINS WITH DIANIN'S COMPOUND. Kuleshov, A. P.; Trofimov, V. L; Chkheidze, I. I. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 75-76(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 82-84(1973).

An ESR study of radicals formed by γ irradiation of the inclusion compound of nitromethane or nitroethane with 2,2,4-trimethyl-4-hydroxyphenyl-2,3-dihydrobenzopyran (Dianin's compound) is reported. ESR spectra are given for nitromethane at 77, 140, and 230°K and for nitroethane at 77, 150, and 260°K. (DHM)

20787 FORMATION OF FREE RADICALS DURING THE RADIOLYSIS OF HYDROCARBON POLYMERS CONTAINING SULFUR ATOMS AND OF PHOSPHAZENE POLYMERS. Kozlov, V. T.; Pashinin, V. I.; Kashevskaya, N. G.; Lanin, S. N. (Scientific-Research Inst. of the Rubber Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 77-79(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 85-86(1973).

The effect of the molecular structure of hydrocarbon polymers containing a sulfur atom in the chain (which were compared to the corresponding hydrocarbon polymers) and of phosphazenes on the radiation yields of the radicals (G_R) and on the ESR spectra which were obtained by irradiating the samples with ^{60}Co γ-rays at 77°K was investigated. The magnitudes of G_R were determined from the initial (for a dose of 3 to 5 Mrad for the hydrocarbons containing sulfur atoms and 5 to 10 Mrad for the phosphazenes) linear portions of the curves of the accumulation of the radicals during the radiolysis of the polymers investigated. (auth)

20788 LUMINESCENCE OF SOLUTIONS OF URANYL SALTS UNDER THE ACTION OF THE INTRINSIC α RADIATION OF ^{238}U AND ELECTROCHEMILUMINESCENCE OF THESE SOLUTIONS. Parshin, G. S.; Kazakov, V. P.; Protopopov, Kh. V.; Chakheeva, O. I. (Inst. of Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 23-27(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 30-35(1973).

Self-luminescence of solutions of UO_2^{2+} salts was detected in concentrated acids (sulfuric, phosphoric, nitric). It was shown that the luminescence intensity increases nonlinearly with increasing uranyl concentration. The nonlinearity is explained by the dual role of UO_2^{2+}: on the one hand as a source of α particles, and on the other as an acceptor of the energy of radiation reactions in the track and an emitter of photons. The temperature dependence of the intensity and the spectral region of luminescence were studied. From the results of an electrochemiluminescence investigation of a solution of UO_2^{2+} in H_2SO_4, an estimate was made of the rate of recombination of the substances formed at the anode and cathode. (auth)

20789 RADIOLUMINESCENCE OF ORGANIC SUBSTANCES. VII. Yields of Excited States in Frozen Solutions During X-Ray Excitation. Spurny, F.; Andreeshchev, E. A.; Kilin, S. F. High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 8-12(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 11-17(1973).

Measurements were made of the radiation yields of singlet (fluorescent) and triplet (phosphorescent) states of 2,5-diphenyl-1,3,4-oxadiazole (PPD), naphthalene, and benzene in ethanol, cyclohexane, a mixture of two parts cyclohexane and five parts isooctane, and toluene during x-ray excitation at 77°K. The mechanism of the formation of excited states (ES) of the luminophores is discussed, and the following conclusions are drawn: (a) in toluene the ES of luminophores are formed as a result of migration of singlet and triplet excitons along the solvent molecules; (b) in aliphatic frozen solvents and alcohol, a substantial fraction of the triplet states of the luminophores are excited by slow "subexciting" electrons; (c) the singlet and triplet states of the luminophores in aliphatic solvents and alcohols are formed in different ways. (auth)

20790 GAMMA RADIOLYSIS OF LIQUID ISOPROPANOL IN THE TEMPERATURE INTERVAL FROM –78 TO +230°C. Afanas'ev, A. M.; Kalyazin, E. P. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 13-16(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 18-22(1973).

The qualitative and quantitative composition of the products of liquid phase radiolysis of isopropanol in the temperature interval from –78 to +230°C was studied. Two regions of temperature dependence were detected. At low temperatures the yield of the decomposition of isopropanol increases weakly with increasing temperature, being characterized by a value of the effective activation energy ~0.5 kcal/mole. In the region of 150°C and above, chain processes develop, initiated by thermal dissociation of hydroxyisopropyl radicals at the C–C bond; in this case the effective activation energy of the decomposition of the alcohol will be ~5 kcal/mole. (auth)

20791 RADICALS IN γ-IRRADIATED HYDRATE CLATHRATES OF THREE-MEMBERED RINGS. Trofimov, V. I.; Blyumenfel'd, A. L.; Kostyanovskii, R. G.; Chkheidze, I. I. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 17-22(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 23-29(1973).

The ESR method was employed to determine the nature of the radicals formed during γ-irradiation at –196°C of three-membered cyclic compounds: cyclopropane (CP), ethylene oxide (EO), propylene oxide (PO), and N-methylethylenimine (MEI) and their hydrate clathrates. The good resolution of the spectra of the radicals present in the cavities of the clathrates and their high stability under these conditions permitted a more reliable identification of the radicals formed. In irradiated CP and PO, cyclic radicals (i.e., there is a cleavage of C–H bonds) and linear radicals (opening of the ring during cleavage of C–C and C–O bonds) are observed; in irradiated EO, only linear radicals, formed in the dissociation of C–C and C–O bonds, are recorded by the ESR method. A comparison of the nature of the radicals in three- and five-membered cyclic compounds is performed. (auth)

20792 RADIATION-CHEMICAL CONVERSIONS OF ANTHRACENE AND PARA-AMINOAZOBENZENE OF ALUMINUM AND GOLD SURFACES UNDER THE ACTION OF ^{60}Co GAMMA RAYS. Doroshenko, V. N.; Chervetsova, I. N.; Kabakchi, A. M. (Inst. of Physical Chemistry, Kiev). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 35-38(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 44-47(1973).

The effect of metals on the radiation-chemical decomposition of para-aminoazobenzene and the extinction of the photoluminescence of anthracene in adsorbed layers containing 4 to 120 molecules per 100 $Å^2$ and in thick crystalline films of thickness 60–160 μ were studied. It is shown that during adsorption on gold, a metal of high atomic number (Z = 79), the degree of radiolysis of the adsorbed substances surrounded by a solid layer differs little from that on aluminum (Z = 13) and in the homogeneous phase. In crystalline anthracene plates (60 to 160 μ), the degree of decomposition on gold and aluminum is higher by factors of 1.65 and 1.1, respectively, than in the homogeneous phase. It is assumed that the absorbed energy is redistributed between the metal and the thin adsorbed layer of the substance. (auth)

20793 γ-RADIOLYSIS OF AQUEOUS SOLUTIONS OF METHANOL SATURATED WITH AIR. Pribush, A. G.; Brusentseva, S. A.; Shubin, V. N.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 32-34(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 41-43(1973).

The γ-radiolysis of aqueous solutions of methanol containing oxygen was studied. The oxidation of the methanol takes place in two macroscopic stages. Because of the low value of the radiation-chemical yield of the absorption of oxygen $G(-O_2)$, it is assumed that the reaction of the radical $\dot{C}H_2OH$ with oxygen has no appreciable influence on $G(-O_2)$. (auth)

20794 RADIOLYSIS OF AQUEOUS SOLUTIONS OF ETHYLENE GLYCOL IN THE PRESENCE OF OXYGEN. Kartasheva, L. I.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 28-31(1973).

Translated from Khim. Vys. Energy.; 7: No. 1, 36-40(1973).

The γ radiolysis of aqueous solutions of ethylene glycol containing oxygen was studied. The radiation yields of glycolaldehyde, formaldehyde, and hydrogen peroxide were measured as functions of the concentration of ethylene glycol and oxygen and also of the acidity of the solution. The yields of aldehydes increase with a rise in the concentration of ethylene glycol, while the yield of H_2O_2 scarcely depends on the concentration of the glycol. The yields of aldehydes are higher for solutions saturated with air than for solutions saturated with oxygen. A mechanism of the radiolysis of this system was proposed on the basis of the results obtained, and the ratio of the rate constants was determined: $k(H + O_2)/k(H + CH_2OHCH_2OH) = 450$. (auth)

20795 EFFECT OF CYCLIC CONFIGURATION ON THE RADIOLYSIS OF HYDROCARBONS. Foldiak, G.; Cserep, G.; Horvath, Z.; Wojnarovits, L. (Isotope Inst., Budapest). Izotoptechnika; 16: No. 6, 297-306(Jun 1973). (In Hungarian).

Differences between the yields obtained in the γ radiolysis of aliphatic and cyclic hydrocarbons are interpreted by the configuration of their molecules. (auth)

20796 PULSE RADIOLYSIS AND INACTIVATION OF TRYPSIN. Ovadia, J. (Michael Reese Hospital, Chicago). Israel J. Chem.; 10: No. 6, 1067-1077(1972).

A study of the mechanism of aqueous trypsin inactivation by radiation was carried out by pulse radiolysis and steady irradiation in the presence of various scavengers. The initial products consist of OH radical and H atom adducts to tryptophan residues, and of electron adduct to cystine residues. Essentially, all OH react with tryptophan with $k(OH + trypsin) = (8.2 \pm 1.2) \times 10^{10}\ M^{-1}\ sec^{-1}$. The electron adduct to the disulfide bond accounts for about 60% of the electron yield, with $k(e_{aq} + trypsin) = (3.5 \pm 0.8) \times 10^{10}\ M^{-1}\ sec^{-1}$. Measurements of tryptophan residue loss and sulfhydryl formation under different irradiation conditions show that the initial reactions are substantially reversible, except for the destruction of tryptophan under aerobic conditions. Many primary radicals induce inactivation with low independent probabilities, indicating that only a small fraction of the possible reaction sites for each species influence the integrity of the active center. (auth)

20797 RADIOLYSIS OF RIBONUCLEASE IN CONTROLLED ENVIRONMENTS. Adelstein, S. J.; Mee, L. K.; Stein, G. (Harvard Medical School, Boston). Israel J. Chem.; 10: No. 6, 1059-1066(1972).

The separate contributions of the primary aqueous radicals to the changes in activity, molecular configuration, and amino acid composition of RNase, produced by γ-irradiation of dilute solutions, were identified. The most effective radical for inactivation is the H atom. Additional molecular products are formed on irradiation of the enzyme. Amino acid analyses of the irradiation products show significant damage only to the aromatic and sulfur-containing residues. (auth)

20798 CONSECUTIVE RADICAL REACTIONS AND THE ROLE OF THE PROTEIN IN THE PULSE RADIOLYSIS OF ENZYMES. Lichtin, N. N. (Boston Univ.). Israel J. Chem.; 10: No. 6, 1041-1058(1972).

The reactions of H atoms, OH radicals, and hydrated electrons acting as isolated reagents upon ribonuclease in dilute aqueous solution were studied by the technique of pulse radiolysis–kinetic spectroscopy. The experiments show that initial action of these reagents upon the protein molecule is followed by intramolecular transformations. Two consecutive intramolecular steps were observed in the reaction of H atoms, with specific rates of approximately $10^3\ sec^{-1}$ and $1\ sec^{-1}$. Some spectral features can be assigned to specific radical sites. For instance, electron adduct to disulfide is formed by the primary action of H atoms at pH 6.6, by the primary action of hydrated electrons at pH 7.6, and by intramolecular reaction of primary product formed by action of OH at pH 7. (auth)

20799 ELEMENTARY STEPS IN THE ACTION OF ELECTRON TRANSFER PROTEINS. Faraggi, M. (Nuclear Research Center Negev, Beersheva, Israel); Pecht, I. Israel J. Chem.; 10: No. 6, 1021-1039(1972).

The applicability of the pulse radiolysis technique for understanding the electron transfer mechanism in redox proteins is presented. It is also suggested that the observed redox reactivity of the protein is correlated to its structural features.

20800 REDUCTION OF FERRICYTOCHROME C STUDIED BY PULSE RADIOLYSIS. Nilsson, K. (Danish Atomic Energy Commission Research Establishment, Risoe). Israel J. Chem.; 10: No. 6, 1011-1019(1972).

The formation of ferrocytochrome c upon pulse radiolysis of aqueous solutions of ferricytochrome c was studied by following spectral shifts at 550 nm and 700 nm. The reaction between ferricytochrome c and hydrated electrons was studied by following the decay of hydrated electrons as well as the ferrocytochrome c formation. The two processes proceed with the same rate which indicate diffusion-controlled processes with a second order rate constant of $1.1 \times 10^{11}\ M^{-1}\ sec^{-1}$. The reaction between ferricytochrome c and H atoms was studied in a system containing H atoms only and found to be a second order reaction with a rate constant of $1.5 \times 10^{10}\ M^{-1}\ sec^{-1}$. The formation of ferrocytochrome c by reaction between ferricytochrome c and OH radicals proceeds by a first step with a second order rate constant of $1.4 \times 10^{10}\ M^{-1}\ sec^{-1}$ during which OH radicals react with the protein part of ferricytochrome c forming an organic radical. Some of these radicals then undergo intramolecular reduction with a rate constant of $3.1 \times 10^3\ sec^{-1}$. (auth)

20801 SOME BIOCHEMICAL PROCESSES INDUCED BY RADIATION AS STUDIED BY PULSE RADIOLYSIS. Swallow, A. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Israel J. Chem.; 10: No. 6, 999-1010(1972).

The main types of biochemically important electron transfer substances can be made to undergo reactions under irradiation which in some ways mimic those which occur in nature. In the case of nicotinamide adenine dinucleotide (NAD^+), fast electron pulse radiolysis shows that electrons add to the pyridine ring forming an NAD· radical with a characteristic absorption in the visible range which is capable of transferring its electron to oxygen. Using simpler pyridinyl compounds it was found that, as well as the absorptions in the visible range, the radicals exhibit absorptions in the infrared range which correlate well with transitions which may be deduced from the known charge-transfer bands of the parent compound. The NAD· radical can be made by one-electron oxidation of NADH as well as by reduction of NAD^+, and the reaction with oxygen enables NADH to be converted into NAD^+ by an unambiguous free radical route. Cytochrome-c can be reduced either by hydrated electrons or CO_2^-. In solution buffered to neutral pH, the reduction gives rise immediately to normal reduced cytochrome-c, but in mildly alkaline solution, an unstable reduced form appears whose conformation changes over a fraction of a second to that of normal reduced cytochrome-c. As well as the hydrated electron and CO_2^-, the superoxide anion radical O_2^- was also found to reduce cytochrome-c. This reaction is very slow ($k \sim 10^5\ M^{-1}\ sec^{-1}$). (auth)

20802 USE OF FREE RADICAL PROBES IN THE STUDY OF MECHANISMS OF ENZYME INACTIVATION. Adams, G. E. (Mount Vernon Hospital, Northwood, Eng.); Redpath, J. L.; Bisby, R. H.; Cundall, R. B. Israel J. Chem.; 10: No. 6, 1079-1093 (1972).

Some inorganic radical-anions, which have very strong absorption spectra, have some oxidative reaction specificity with amino acids. Combined pulse radiolysis and inactivation studies on the reactions of these radicals with several enzymes lead to identification of amino acid residues essential to enzymic activity. Data are reviewed for the enzymes, lysozyme, ribonuclease, trypsin, α-chymotrypsin, papain, and carboxypeptidase. The reducing radical, CO_2^-, is more selective than the hydrated electron in its reactions with enzymes and proteins. Results from pulse radiolysis studies in electron-transfer and other reactions involving CO_2^- are compared with results from inactivation studies with lysozyme and ribonuclease. (auth)

20803 RADIATION-INDUCED HYDROGEN TRANSFER IN NUCLEIC ACIDS AND PROTEINS IN THE SOLID STATE. Riesz, P.; Smitherman, T. C. (National Cancer Inst., Bethesda, MD). Israel J. Chem.; 10: No. 6, 1165-1184(1972).

A radioinduced transfer of hydrogen from exchangeable to carbon-bound sites occurs in nucleic acids, proteins, and their constituents. The G values for this process are similar within a factor of 2 to 3 to the G values for the initial production of stable radicals measured by ESR at room temperature. Unlike the production of radicals, hydrogen transfer in ribonuclease, DNA, and thymine is a linear function of dose in the 0 to 30 Megarad region. The tritium distributions obtained in proteins by hydrogen transfer are not a measure of the distribution of the "secondary" radicals. From the studies of the effect of temperature, of various scavengers (particularly nitric oxide) and of the dose dependence in the low dose region, it was inferred that for ribonuclease most of the hydrogen transfer takes place during the conversion of the radicals stable at 195°K to the radicals stable at room temperature. The same mechanism also appears to predominate in DNA. (auth)

20804 PRIMARY EVENTS IN THE RADIOLYSIS OF NUCLEIC ACIDS AND THEIR COMPONENTS. Scholes, G. (Univ. of Newcastle-upon-Tyne, Eng.). Israel J. Chem.; 10: No. 6, 1107-1122 (1972).

The radiolysis of dilute aqueous solutions of DNA and its components is discussed, with particular reference to the rates of reaction and the sites of reaction of the primary reactive species, OH, H, and e_{aq}^-. Recent work on the formation and subsequent reactions of OH^- and electron-adducts of pyrimidines is described. (auth)

20805 RADIATION CHEMISTRY OF ETHYLENE GLYCOL, MESOERYTHRITOL, 2-DEOXY-D-RIBOSE, AND ALKYL PHOSPHATES AS DNA MODEL COMPOUNDS. Schulte-Frohlinde, D.; von Sonntag, C. (Max Planck Institut fuer Kohlenforschung Abteilung Strahlenchemie, Ruhr, Ger.). Israel J. Chem.; 10: No. 6, 1139-1150(1972).

The γ radiolysis of ethylene glycol, meso-erythritol, 2-deoxy-D-ribose, and alkyl phosphates was studied in diluted (10^{-2} M), N_2O-saturated, deoxygenated aqueous solutions. Products and their G values were determined. Reaction schemes were derived from complete material balances. In the polyols the primary attack of the radiolytically formed OH radicals and H atoms leads to α,β-dihydroxyalkyl radicals (A) which eliminate water to give substituted α-carbonyl-methyl radicals (B): $-COH-CHOH-$ (A) $\rightarrow$ $-CO-\dot{C}H-$ (B) + H_2O. Disproportionation reactions of the radicals A and B yield products having the structural units $-CO-CHOH-$ and $-CO-CH_2-$. In ethylene glycol a chain reaction is induced, radical B abstracts a hydrogen from ethylene glycol to give acetaldehyde and radical A. In 2-deoxy-ribose the major attack is at C-1. Products from this radical are 2-deoxy-ribonic acid and 2,5-dideoxy-ribonic acid. In the formation of the latter a rearrangement is involved. With trimethyl phosphate, the reaction of the solvated electron is only small (2×10^5 l/mole sec), as shown by pulse radiolysis. Dimethyl and methyl phosphates do not react with the solvated electron to a measurable extent. The attack of the OH radical apparently leads to a cleavage of the alkyl phosphate linkage. (auth)

20806 STUDY ON THE IRRADIATION BEHAVIOR OF THE ION EXCHANGER RESINS OF THE VIONITE TYPE. II. Cation Exchanger Resins. Oltenasu, M.; Knall, H. Rev. Chim. (Bucharest); 24: No. 5, 374-377(May 1973). (In Rumanian).

The effects of the exchange ion on the radiation stability of the resin were followed by working in the humid state with the forms H^+, Na^+, Ca^{2+}, and Fe^{3+}, at different radiation doses. At constant dose ($D_1 = 10^8$ rad), the influence of the degree of reticulation on the stability of the resin, for the forms H^+ and Na^+ was studied. In all the cases, the exchange capacity, the water content, and the specific weight of the resin were determined. The resin Vionite CS-3 undergoes structural changes at integral doses exceeding 1×10^8 rad. (auth)

20807 RADIATION TREATMENT OF ACIDIC AQUEOUS SOLUTIONS. Steinberg, M.; Prozansky, J. (to United States Atomic Energy Commission). Australian Patent 424,372. 15 May 1972. Priority date 3 Nov 1967, United States of America (USA).

A process is described for treating acidic aqueous solutions having a pH below 6.0 and containing ferrous iron compounds by radiolytically converting the ferrous iron compounds to ferric iron compounds and contacting the ferric iron compounds with calcium carbonate to precipitate the ferric iron compounds out of solution. (auth)

20808 CHANGE OF THE PROPERTIES OF CAOUTCHOUCS AND VULCANISATES BY IONIZING IRRADIATION. 2. Mozisek, M. (Sigma, Olomouc, Czech.). Kaut. Gummi Kunstst.; 26: No. 3, 92-97(1973). (In German).

Topics considered include the ingredients of mixtures influencing the irradiation stability of polymers; radioprotective substances; and the irradiation stability of different elastomers (butyl- and silicon-caoutchoucs, rubbers containing fluorine, polychloroprenes, butadiene-acrylnitrile caoutchoucs, chlorosulfonated polyethylenes, acrylate caoutchoucs, butadiene-styrene caoutchoucs, natural rubbers, polyisoprene and polyurethanes). (GE)

20809 CHANGE OF THE PROPERTIES OF CAOUTCHOUCS AND VULCANISATES BY IONIZING IRRADIATION. 1. Mozisek, M. (Sigma, Olomouc, Czech.). Gummi Kunstst.; 26: No. 2, 49-52(1973). (In German).

Topics discussed in the review are radiation sources consisting of radioisotopes, electron beam, and x-ray sources; the mutual influence of ionizing radiation and matter with respect to the behavior of free radicals and excited molecules; and the cross-linking and cleavage of caoutchoucs by ionizing radiation. (GE)

20810 RADIATION-INDUCED GRAFT REACTION OF POLYETHYLENE WITH UNSATURATED AND CARBONYL COMPOUNDS AS PHOTOOXIDATIVE DEGRADABLE GROUPS. Kagiya, T.; Miyoshi, K.; Takemoto, K.; Ogawa, H.; Ikeda, N. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 65-72(Jan 1973).

In order to give a photo-oxidative degradable nature to polyethylene, γ-ray-induced graft reaction of unsaturated and carbonyl compounds was studied. The grafting was performed in an atmosphere of these compounds with thin films by the in-source γ-irradiation technique at room temperature. A large amount of 1,3-butadiene or an α,β-unsaturated carbonyl monomer was grafted to polyethylene. The amount of grafted monomers was increased by co-grafting of the mixture of these monomers. According to the role of unsaturated carbonyl compounds to the graft copolymerization of the mixture with butadiene, these compounds can be divided into two types: one made the increase in only the amount of combined butadiene with the constant ratio of terminal vinyl to trans-vinylene unsaturation, but gave little increase in that of a carbonyl compound. The other made the increase in the amount both of combined monomers, and the ratio of terminal vinyl to trans-vinylene changed with the molar ratio of the mixture. (auth)

20811 RADIOLYTIC EFFECTS OF GAMMA RAYS ON ALPHA-AMYLASE IN AQUEOUS SOLUTION. Tanabe, R. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 37-43(Jan 1973).

In order to investigate the effects of irradiation on the peptide bonds of this enzyme protein, search for small peptides by gel filtration, measurement of molecular weight by ultracentrifugal analysis and determination of N-terminal amino acid by the DNP method were carried out in the intact enzyme and irradiated one. From the results obtained from these experiments, it was concluded that the peptide bonds did not accept any cleavage by the irradiation. Irradiation by γ-rays of α-amylase in aqueous solution was found to reduce the amount of several amino acid residues to some extent, such as lysine, histidine, arginine, tyrosine and so on. Free ammonia was liberated from the enzyme protein by the irradiation with γ-rays. The degree of liberation of the free ammonia was proportional to that of inactivation and was independent of the enzyme concentration at the irradiation. It was assumed that the liberation of the ammonia was due to the destruction on the basic amino acid residues in this protein molecule. (auth)

20812 EFFECT OF THE ADDITION OF BORON COMPOUNDS ON HYDRAZINE FORMATION IN THE RADIOLYSIS OF AN AQUEOUS SOLUTION OF AMMONIA. Takemi, H.; Watanabe, A.; Shinagawa, M. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 5, 268-273(May 1973).

The effect of boron compound additives on hydrazine formation in the radiolysis of an aqueous solution of ammonia was studied. Suitable boron compounds such as NH_4BF_4 and $C_2H_5NH_2BF_3$ were used as source of $^{10}B(n,\alpha)^7Li$ reaction. Ammonium hydroxide containing an additive was irradiated with thermal neutrons in the re-

actor KUR. When NH_4BF_4 was added to 15 M ammonium hydroxide, the yield of hydrazine depended on the boron concentration but did not depend on the irradiation time. On the other hand, hydrazine formed in the presence of $C_2H_5NH_2BF_3$ had a maximum value at about 5×10^{21} eV/ml absorption dose. The characteristics of the added boron compounds are discussed with comparisons made between radiolysis incited by in-pile and ^{60}Co γ irradiation. The effects of the additives are explained in terms of the hot atom effect of $^{10}B(n,\alpha)^7Li$ reaction and the protecting effect of the resulting Lewis type acid, which inhibits the decomposition of hydrazine by scavenging the ·H and $\cdot NH_2$ radicals. (auth)

20813 ESR OF GAMMA-IRRADIATED DGN. Ohashi, S.; Abe, R.; Kawamura, A. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 34: No. 6, 1694(Jun 1973).

The ESR spectra of radicals formed in γ-irradiated diglycine nitrate, $(NH_2CH_2COOH)_2HNO_3$, (DGN), at the X-band were measured. The g- and A-tensors were determined for the NO_3^{2-} radical (found at 77°K) and the $CH_3\dot{C}HCOO^-$ radical (found at room temperature). A third radical $NH_3\dot{C}HCOO^-$ was found, but could not be analyzed in the present experiment. (JGB)

20814 TUNNELLING ROTATION OF A DEUTERATED METHYL GROUP. Clough, S.; Poldy, F. (Univ. of Nottingham, Eng.). J. Phys., C (London); 6: No. 14, 2357-2365(23 Jul 1973).

Electron spin resonance and electron nuclear double resonance measurements on free radicals of structure $CD_3\dot{C}(COOH)_2$ in γ-irradiated single crystals of partially deuterated methylmalonic acid are reported. The results show that the CD_3 groups undergo rapid tunnelling rotation at 4.2°K, indicating a lower hindering barrier than in the analogous radical in the undeuterated crystal. Small anomalous shifts of the ENDOR frequencies and broadening of some components of the electron spin resonance hyperfine structure are attributed to a spin rotation interaction arising from the effect of the deuteron quadrupole moment on the hindering barrier, making the probability for tunnelling rotation of the methyl group through $2\pi/3$ depend on the spin state of that deuteron which traverses the hindering barrier during the rotation. (auth)

20815 EFFECT OF CRYSTAL MATRIX ON THE FORMATION OF SOLVENT RADICALS IN THE RADIOLYSIS OF ALKANES IN THE SOLID STATE AT 77°K. Fukaya, M.; Wakayama, T.; Miyazaki, T.; Saitake, Y.; Kuri, Z. I. (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 46: No. 4, 1036-1040(Apr 1973).

The effect of the matrix on the radiolysis of 2,3-dimethylbutane, neopentane, 2,2-dimethylbutane, and isobutane in the solid state was studied at 77°K by means of ESR spectroscopy. Though only the $\cdot CH_2CH(CH_3)CH(CH_3)_2$ radical is formed by the γ-irradiation of 2,3-dimethylbutane in the I crystal, the $CH_3\dot{C}(CH_3)CH(CH_3)_2$ radical is formed by the γ-irradiation of 2,3-dimethylbutane in the II crystal. Though the t-C_4H_9 and neo-C_5H_{11} radicals are formed by the γ-irradiation of pure neopentane, the formation of radicals is affected appreciably by the addition of a small amount of alkanes. When neopentane containing ethane, etc. is γ-irradiated, the solute radical is mainly formed by energy transfer from the γ-irradiated neopentane to the solute. Most of the solutes have a spherical molecular structure like that of neopentane or are smaller than neopentane. When neopentane containing 3-methylpentane, etc. is γ-irradiated, only the neopentyl radical is formed. The molecular structures of the solutes are very different from that of neopentane. The formation of the solvent radical in the radiolysis of 2,2-dimethylbutane is affected by the addition of 3-methylpentane or methylcyclohexane. The formation of the butyl radical in the radiolysis of isobutane is also changed drastically by addition of alkanes. It is concluded that the formation of solvent radicals in the radiolysis of solid alkane is appreciably affected by the conditions of the matrix. (auth)

20816 ESR OF HOT IONS: Ni(I) COMPLEX IONS PRODUCED IN SOLID SOLUTIONS BY GAMMA IRRADIATION. Amano, C.; Fujiwara, S. (Tokyo Univ.). Bull. Chem. Soc. Jap.; 46: No. 5, 1379-1383(May 1973).

Electron spin resonance was used to study Ni(I) complex ions produced at 77°K through reduction by γ-irradiation of Ni(II) complexes in glassy solvents. The Ni(I) complex ions give axially symmetrical spectra, suggesting that the Ni(I) ions favor tetragonally elongated octahedral form. From the g-values it can be shown that the Ni(I)-to-ligand bonding for different ligands increases in covalency in the order: H_2O < edta ≪ py ~ en ~ xanthate < phen < dipy ≪ CN^-. It can also be shown that the metal-to-ligand bonding of the Ni(I) complex ions is less covalent than that of the corresponding Cu(II) complexes. Measurement of the integrated intensity of the ESR spectrum of $[Ni(I)(H_2O)_6]^{+}$ with reference to a standard sample of $[Cu(II)(H_2O)_6]^{2+}$ shows that at a total dose of 1×10^6 R the yield of the Ni(I) species is 0.21 ± 0.04% of the host complex $[Ni(II)(H_2O)_6]^{2+}$. In addition to the anisotropic spectra of the Ni(I) complex ions, isotropic spectra were observed in several cases, which are probably due to Ni(III) complex ions. Isotropic feature of these spectra may be explained in terms of dynamic Jahn-Teller effect involving the Ni(III) complex ions. (auth)

20817 ESR STUDIES ON RADIATION-INDUCED POLYMERIZATION OF 1,3-BUTADIENE IN UREA CANAL COMPLEXES. Ohmori, T.; Ichikawa, T.; Iwasaki, M. (Government Industrial Research Inst., Nagoya, Japan). Bull. Chem. Soc. Jap.; 46: No. 5, 1383-1388(May 1973).

The ESR spectrum of γ-irradiated 1,3-butadiene in urea canal complexes at 77°K consists of 7 lines with a hyperfine splitting of 15 G and is assigned to the monomer radical $CH_3-CH=CH-\dot{C}H_2$ which may be produced by hydrogen addition to the 1,3-butadiene. Upon warming to room temperature the spectrum changes into a 6×2-line spectrum (a_1 = 14 G and a_2 = 4 G), which is attributed to the propagating radical $R-C_8H_2-C_4H=CH-\dot{C}H_2$ occluded in the urea canals. On cooling back to 77°K, the 6×2-line spectrum is transformed into a 5-line spectrum (a = 14 G); this spectral change is reversible with temperature and is interpreted in terms of oscillation of the propagating radical around the $C_\beta-C_\alpha$ bond. On further warming to 400°K, the propagating radical is converted to the chain allyl type radical $R-CH_2-CH=CH-\dot{C}H-CH_2-R'$, of which room-temperature spectrum consists of 7×2 lines (a_1 = 14 G and a_2 = 4 G). This radical conversion is explained by hydrogen atom transfer reaction within the propagating radical through the radical chain and/or between the propagating radical and a neighbouring polymer chain. Irradiated 1,3-butadiene-1,1,4,4-d_4 in urea canals is also examined and the results obtained confirm the above-mentioned identifications. (auth)

20818 CHEMICAL APPROACH TO THE RADIOLYSIS OF POLYPHOSPHATE GLASS. I. Effects of Sb(III,V), Mo(V,VI) AND U(IV,VI) IONS. Kobayashi, Y.; Matsuura, N. (Tokyo Univ.). Bull. Chem. Soc. Jap.; 46: No. 5, 1346-1353(May 1973).

The yields of radiation-induced electrons and holes trapped in the glass matrix are easily determined by introducing metals ions, such as Sb, Mo, and U ions, into water-soluble $NaPO_3$ polymer glass. Doping 1 mol% of these ions of a lower oxidation state wholly prevents the trapping of holes and results in oxidation to their higher oxidation states. A reaction in the reverse direction also occurs for the same ions of a higher oxidation state, which are converted into a lower one by reduction. This radiation-induced redox reaction has a minimum yield at a dopant composition corresponding to Sb_2O_4 for Sb(III)-Sb(V), Mo_4O_{11} for Mo(V)-Mo(VI), and U_3O_8 for U(IV)-U(VI) redox couples. The largest effective volume among these ions for capturing the holes is for Sb(III). In a high-dose region (10^{20} to 10^{21} eV/g), the yields of the redox products of these ions increase logarithmically with the γ-dose absorbed. This makes it difficult to determine the G-value of the redox products precisely. The approximate values are in an order of magnitude of 0.1 atom per 100 eV absorbed. (auth)

20819 RADIATION-INDUCED GRAFT POLYMERIZATION OF ACRYLONITRILE ONTO POLY(VINYL CHLORIDE) FILM. Hashimoto, S.; Udagawa, A.; Kageyama, E. (Japan Atomic Energy Research Inst., Takasaki). Nippon Kagaku Kaishi; 1973: No. 6, 1188-1194(Jun 1973). (In Japanese).

The effects of film thickness upon the graft polymerization of acrylonitrile onto poly(vinyl chloride) film ranging from 0.3 to 0.007 mm were studied by simultaneous irradiation technique with 2 MeV electron beam at room temperature. The reaction rate was observed to increase with the reaction time at the initial stage, and then decrease in a following stage. A remarkable heterogeneity of the graft concentration distribution was also observed at the cross section of the grafted films. These phenomena were shown to be caused by the change of the internal monomer concentration which is determined by the difference of the consumption rate of monomer in the films and the diffusion from the surface. (auth)

20820 RADIATION CURING OF UNSATURATED POLYESTER COMPOSITIONS. Lamb, G. E. R.; Prevorsek, D. C.; Oswald, H. J. (to Allied Chemical Corp.). U. S. Patent 3,719,539. 6 Mar 1973. Filed date 22 Aug 1969. 4p.

A cold-forming method for forming shapes from a laminate which has a thermosetting resinous core and thermoplastic face sheets is disclosed. The thermoplastic face sheets are of sufficient thickness and strength so that the sandwich containing the thermosetting core between the face sheets may be cold formed into shaped articles. The shape that is imparted to it is retained by the thermoplastic face sheets without substantial external constraint on the shape as the thermosetting core is cured by a catalyst system consisting essentially of a peroxide catalyst in conjunction with high energy radiation. (auth)

20821 IRRADIATION OF VINYL MONOMERS IN THE PRESENCE OF PARAFFIN WAXES. Thomas, A. C.; Du Plessis, T. A.; Oosterhuis, A.; Oosterhuis, H. (Atomic Energy Board, Pretoria). J. Appl. Polym. Sci.; 17: No. 8, 2519-2522(Aug 1973).

The γ radioinduced grafting of a series of monomers onto a wide range of paraffin waxes was attempted. Although no grafting could be achieved and only homopolymers were formed, the rates of homopolymerization were greatly enhanced in the presence of the wax. This phenomenon is ascribed to processes of energy transfer from the irradiated wax to the monomer. (auth)

20822 FAST INTRAMOLECULAR RADICAL PROCESSES IN REACTIONS OF AQUEOUS SOLUTIONS OF RIBONUCLEASE-S-PEPTIDE AND RIBONUCLEASE-S-PROTEIN WITH H ATOMS. Lichtin, N. N.; Ogdan, J.; Stein, G. (Boston Univ.). Radiat. Res.; 55: No. 1, 69-80(Jul 1973).

The reactions of H atoms with ribonuclease-S-peptide and ribonuclease-S-protein at pH 2.2 and 6.6 were investigated by means of pulse radiolysis–kinetic spectrometry and compared with those of intact ribonuclease. Initial spectra were observed after 100-nsec pulses of 5 MeV electrons under conditions such that only H atoms reacted with substrate. The resulting spectra are due to addition of one H atom to a substrate molecule. Their subsequent transformations were studied over periods ranging from several microseconds to several seconds. The specific rates of reaction of H atoms with S-protein and with intact ribonuclease are the same, while S-peptide reacts about half as rapidly. For both substrates the subsequent transformations are first order and presumably correspond to intramolecular chemical reactions. The data implicate aromatic and sulfur-containing amino acid residues as transient radical sites. The data for S-peptide establish that intramolecular radical transfer is a reaction of polypeptide as well as of protein. The types of residues involved as radical sites and the intramolecular nature of sequential transformations are similar to those observed in the reaction of intact ribonuclease with H atoms, but significant differences are observed in specific rates and spectra. The sum of the effects of H atoms on S-peptide and on S-protein separately is not identical with the action of H atoms on structurally intact ribonuclease. (auth)

20823 REACTIONS OF HYDROGEN ATOMS IN AQUEOUS SOLUTIONS: THIOLS. Tung, T. L.; Kuntz, R. R. (Univ. of Missouri, Columbia). Radiat. Res.; 55: No. 1, 10-17(Jul 1973).

Rate constants were determined for hydrogen atom reactions with six sulfhydryl compounds which have structures related to known radiation protectors and sensitizers. A competition technique was utilized to evaluate contributions from the two mechanisms: (a) $H + RSH \xrightarrow{k_4} H_2 + RS$, and (b) $H + RSH \xrightarrow{k_5} H_2S + R$. The rate constant for the first reaction is influenced by the presence of functional groups within the molecule. It is also found this reaction is the predominant mechanism for hydrogen atom reaction with primary sulfhydryl compounds while the second reaction is most important for secondary and tertiary SH groups. The relationship of these results to observed radiation protection and sensitizing properties of sulfhydryl compounds is discussed. (auth)

20824 GRAFT COPOLYMER MODIFICATION OF POLYETHYLENE–POLYSTYRENE BLENDS. I. Graft Preparation and Characterization. Locke, C. E.; Paul, D. R. (Univ. of Texas, Austin). J. Appl. Polym. Sci.; 17: No. 8, 2597-2617(Aug 1973).

The preparation and characterization of styrene–low-density polyethylene graft copolymers for addition to blends of polyethylene and polystyrene to improve blend mechanical properties is described. The direct method of grafting with ^{60}Co radiation was employed using the polyethylene in pellet form. The approach gave good grafting efficiency with maximum yields limited to about 1 g of styrene reacted per gram of polyethylene. Excessive crosslinking at radiation doses beyond about 1 mrad was detrimental to the melt processibility of the graft. Crystallinity, dynamic mechanical properties, morphology, and stress–strain behavior of the grafts were examined and compared with melt blends of similar composition in order to better characterize the material produced. (auth)

20825 RADIATION CROSSLINKED, SWELLED SEMIPERMEABLE MEMBRANES. Coughlin, R. W.; Siegel, R. D. (to Research Corp.). U. S. Patent 3,720,321. 13 Mar 1973. Filed date 11 Mar 1970, 8p.

A method is presented for preparing a semipermeable membrane of enhanced permeability or permselectivity. It is formed by swelling a cross-linkable polymer film in a nonreactive, nonpolymerizable swelling agent for a time sufficient to uniformly penetrate and swell the film, then subjecting the swollen film to high-energy ionizing radiation for a period of time and at a dose rate sufficient to cause cross-linking of the polymer. (auth)

20826 ELECTRON SPIN RESONANCE STUDIES OF ELECTRON-IRRADIATED PEPTIDES. A Single Crystal of N-Acetylglycine at 77 K. Saxebol, G.; Melo, T. B.; Henriksen, T. (Univ. of Oslo). Radiat. Res.; 55: No. 2, 356-368(Aug 1973).

Free radicals formed in single crystals of N-acetylglycine, irradiated and observed at 77°K, were studied using ESR spectroscopy. Two different radical species were found. One radical (called R_I) is formed by a decarboxylation process yielding the radical structure $H_3C \cdot CO \cdot NH \cdot \dot{C}H_2$. The isotropic splitting constants for the two α-protons in the methylene group were 18.4 and 18.8 gauss. The identification of the R_I radical was supported by MO calculations carried out at the INDO level of approximation. The other radical formed at 77°K is presumably $H_3C \cdot CO \cdot NH \cdot CH_2\dot{C}OOH^-$, the N-acetylglycine anion. The unpaired electron is located in a π-orbital on the carboxyl carbon and interacts with the two β-protons in the adjacent methylene group. The two β-proton splitting constants were 27.2 and 6.6 gauss. The resonance of the anion radical is usually masked by the resonance of the R_I radical. However, its resonance can be studied after uv illumination of the crystal at 77°K which resulted in a selective decay of the R_I resonance. (auth)

20827 HYDRATED ELECTRON REACTIONS WITH THIOLS IN ACIDIC AQUEOUS SOLUTIONS. Tung, T. L.; Kuntz, R. R. (Univ. of Missouri, Columbia). Radiat. Res.; 55: No. 2, 256-264(Aug 1973).

The rates of hydrated electron reactions with cysteamine, cysteine, thioglycol, α-mercaptopropionic acid, β-mercaptopropionic acid, and penicillamine were studied in the pH 1 to 3 region. Hydrogen yields, which are a function of pH in this region, were used to monitor the competition between H^+ and RSH for hydrated electrons. Corrections were applied to the observed rate constants to account for dissociation of the COOH group and the ionic strength effect on hydrated electron reactions. In the cases of cysteine and penicillamine, the rate constants for reaction with protonated amino acids at infinite dilution were greater by a factor of 3 to 5 than those for reaction with the zwitterion. Uncharged species show no pH dependence of the rate constant within this region. All rate constants measured were of comparable magnitude and approached the diffusion controlled limit. (auth)

20828 FREE-CATIONIC POLYMERIZATION OF STYRENE BY RADIATION. Hayashi, K.; Hayashi, K.; Okamura, S. (Japan Atomic Energy Research Inst., Osaka). Polym. J.; 4: No. 3, 426-436(May 1973).

The cationic polymerization of bulk styrene by radiation was investigated by dilatometry and electrical conductivity measurements. In the sample which attained the highest polymerization rate, R_p in this study the dose rate exponent of R_p was still 0.7, however, a 0.6-power dependence was obtained in oxygen containing samples in which R_p in higher dose rate region was considerably lower than that of oxygen-free one. In well-dried, oxygen-free samples, a non-Ohmic current–voltage relationship was observed. These behaviors can be explained by the coexistence of polymeric anions as well as polymeric cations in well-dried, oxygen-free system. Kinetic calculations of the rate constant for propagation, k_p and its activation energy, E_p were made giving $k_p = (2.4 \pm 0.9) \times 10^6$ l mol^{-1} sec^{-1}, and $E_p = 2.2 \pm 1.3$ kcal mol^{-1}. From the comparison with the previously reported k_p values with other polymerization mechanisms, it is found that k_p with free-cationic mechanism is the highest probably because of its low E_p values. (auth)

20829 PULSE RADIOLYSIS OF METHANE. Rebbert, R. E.; Lias, S. G.; Ausloos, P. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 77A: No. 2, 249-257(1973).

The pulse radiolysis of methane was studied in the absence and presence of electron scavengers such as SF_6 and CD_3I and positive ion scavengers such as i-C_4D_{10} in order to define the role of the intermediates H, C, CH, CH_2, CH_3, CH_5^+, and $C_2H_5^+$ in product formation. The dose rate was varied from 0.68 to 15.2×10^{19} eV/g-s, the dose (number of pulses) was varied, and the duration of the pulse was changed from 3 ns to 100 ns. The variation of the yields of the ethylene and ethane products with dose is explained by the reaction of H-atoms with accumulated ethylene product. The fast reacting C, Ch, and $^1CH_2$ species insert into methane to form acetylene, ethylene, and ethane products, but all of the reactions of these species cannot be completely specified since they may originate in upper electronic states, whose reactions with methane are unknown. Product formation by the slow reacting $^3CH_2$ and CH_3 radicals is also examined; for instance, evidence is presented for the occurrence of the reaction: $^3CH_2 + CH_3 \rightarrow C_2H_4 + H$. Results indicate that the ions CH_5^+ and $C_2H_5^+$ undergo neutralization mainly through the processes: $CH_5^+ + e \rightarrow CH_4 + H$, and $C_2H_5^+ + e \rightarrow (C_2H_6)^* + H \rightarrow C_2H_2 + H + H_2(2H)$. When i-$C_4D_{10}$ is added, a fraction of the CH_5^+ and $C_2H_5^+$ react with the additive

rather than undergo neutralization. A calculation demonstrates that the fraction of ions undergoing reaction with a given concentration of i-C_4D_{10} can be correctly predicted by assuming that the rate constant for neutralization of CH_5^+ and $C_2H_5^+$ is the same as that determined recently for the t-butyl ion. (auth)

20830 ESR AND INDO-MO STUDIES OF RADICALS AND RADICAL REACTIONS IN IRRADIATED SINGLE CRYSTALS OF 5-NITRO-6-METHYLURACIL. Sagstuen, E. (Univ. of Oslo). Radiat. Res.; 55: No. 2, 225-241(Aug 1973).

Single crystals of 5-nitro-6-methyluracil were irradiated with 4.0-MeV electrons and studied at temperatures between 77°K and room temperature by the electron spin resonance technique. Four radicals are formed altogether and three of these were identified. An intermediate radical, stabilized in the temperature region 110 to 250°K is found and its ESR parameters determined. The radical is presumably formed from the primary radical by a double-proton tunneling process. MO calculations carried out at the INDO level of approximation supported the interpretations. The primary radical, formed at 77°K, was found to disappear via two independent reactions when the crystals were warmed to temperatures above 110°K. Both reactions were studied in detail. A previous identification of the room-temperature radical by Snipes and Benson was supported by some recent MO calculations which also showed that the NO_2 group is slightly twisted out of the ring plane. (auth)

20831 GAS PHASE FAR ULTRAVIOLET PHOTOLYSIS AND RADIOLYSIS OF VINYL CHLORIDE. Ausloos, P. (National Bureau of Standards, Washington, DC); Rebbert, R. E.; Wijnen, M. H. J. Res. Nat. Bur. Stand., 77A: No. 2, 243-248(1973).

Quantum yields of the major products formed in the far ultraviolet photolysis of $CH_2CDCl(C_2H_2, C_2HD, C_2H_3D, C_2H_2D_2$, and 1,3-$C_4H_4D_2$) were determined at 147 nm (8.4 eV), 123.6 nm (10.0 eV), and 104.8 to 106.7 nm (11.6 to 11.8 eV). The quantum yield of the stable vinyl radicals which can be unambiguously ascribed to the primary process ($CH_2CDCl + h\nu \rightarrow CH_2CD + Cl$) is 0.3 and 0.05 at 147 and 123.6 nm, respectively. The sharp decrease in the yield of vinyl radicals with the increase in energy of the incident photon beam is in part attributed to the decomposition of internally excited vinyl radicals to give acetylene as a product. At 147 nm, the combined yield of acetylene plus vinyl radicals is 0.95 ± 0.05. At the shorter wavelengths, approximately one acetylene molecule is formed per electronically excited vinyl chloride molecule. It is concluded that the dissociative process: $C_2H_3Cl^* \rightarrow C_2H_2 + H + Cl$, occurring via a C_2H_3 or C_2H_2Cl intermediate adequately accounts for the reactive neutral species formed at higher photon energies. Isotopic labeling experiments show that the hydrogen atoms are detached from both positions of the parent molecule. Ethylene which is a product over the entire wavelength range is in part formed via the reaction: $H^* + C_2H_3Cl \rightarrow C_2H_4 + Cl$, where H* represents a translationally excited hydrogen atom. The $C_2H_2DCl^+$ ions formed at 104.8 to 106.7 nm with a quantum yield of 0.47 do not contribute to the formation of acetylene or vinyl radicals. In the gas phase radiolysis of vinyl chloride, acetylene ($G \sim 1.5$) is mainly formed in the dissociation of neutral electronically excited vinyl chloride molecules. From this value, the ratio of neutral excited molecules formation to ionization in the radiolysis of vinyl chloride is estimated to be 0.39. Vinyl ions, which are also produced ($G \sim 0.28$ to 0.35), react mainly by addition to vinyl chloride. (auth)

20832 EFFECTS OF GAMMA IRRADIATION ON BENZYL THIOCYANATE AND ISOTHIOCYANATE. Sugii, A.; Kitahara, K.; Nagai, K. (Kumamoto Univ., Japan). Radioisotopes (Tokyo); 22: No. 5, 239-242(May 1973).

The effects of ^{60}Co γ irradiation on benzyl thiocyanate (BTC) and benzyl isothiocyanate (BIT) were investigated by gas chromatography and mass spectrometry. The degradation of BTC were 8.8%, 17.4%, and 29.3% and those of BIT were 4.7%, 12.7%, and 16.2% for the irradiation with 1.1×10^8 rad, 2.0×10^8 rad and 3.1×10^8 rad, respectively. Gamma-induced isomerization was observed in both BTC and BIT. In the case of 3.1×10^8 rad irradiation isomerization yield of BIT from BTC was 8.3% and that of BTC from BIT was 1.7%, respectively. Benzene, toluene, benzyl mercaptan, benzyl cyanide, dibenzyl, dibenzyl sulfide, and dibenzyl disulfide were identified and determined among radiolysis products of BTC and BIT. On the other hand, the presence of trimer in both irradiated samples was identified by mass spectrometry. (auth)

20833 EXCITATION TRANSFER IN THE RADIOLYSIS OF SOLID ALKANE MIXTURES AT 77°K. Miyazaki, T.; Wakayama, T.; Fukaya, M.; Saitake, Y.; Kuri, Z. (Nagoya Univ., Japan). Bull. Chem. Soc. Jap.; 46: No. 4, 1030-1035(Apr 1973).

The radiolysis of isobutane–propane (less than 5 mole %) or neopentane–alkane (5 mole %) mixtures was studied at 77°K by means of ESR spectroscopy. When these alkane mixtures are γ irradiated, the solute radicals are mainly formed by energy transfer from γ-irradiated isobutane or neopentane to the solutes. A consideration is made of whether or not the energy transfer is due to a proton transfer, a positive-charge transfer, or an excitation transfer. It is concluded that the energy transfer is probably due to the excitation transfer and that the excitation transfer may occur via highly-excited states of isobutane or neopentane. Reasons given are that the ionization potentials and the energies of the first singlet-excited states of the same additives are higher than those of isobutane or neopentane. The decrease in the solvent radical yields and the increase in the solute radical yields upon the addition of the solutes to the isobutane or neopentane amount approximately to 2 to 2.5 G-units. In addition the yields of hydrogen increase sharply upon the addition of cyclopentane in the radiolysis of solid neopentane. It was concluded in previous studies that the formation of the solvent radical in the radiolysis of solid isobutane is due to the fragmentation of excited isobutane produced directly by γ irradiation. (auth)

20834 PULSE RADIOLYTIC STUDY ON THE $S_4O_6^{3-}$-RADICAL AS AN INTERMEDIATE PRODUCT OF THIOSULPHATE OXIDATION AND TETRATHIONATE REDUCTION. Schoeneshoefer, M. (Hahn Meitner Institut fuer Kernforschung, Berlin). Int. J. Radiat. Phys. Chem.; 5: No. 4, 375-386(Jul 1973). (In German).

The rate constants of the reactions of OH with $S_2O_3^{2-}$ [$k(OH + S_2O_3^{2-}) = 8 \times 10^9$ dm^3 mol^{-1} s^{-1}] as well as e_{aq}^- and CO_2^- with $S_4O_6^{2-}$ [$k(e_{aq}^- + S_4O_6^{2-}) = 6 \times 10^9$ dm^3 mol^{-1} s^{-1}; $k(CO_2^- + S_4O_6^{2-}) = 6 \times 10^7$ dm^3 mol^{-1} s^{-1}] were determined. The first product of the reaction of OH with $S_2O_3^{2-}$ is the $S_2O_3^-$ radical, the absorption coefficients of which decrease to longer wavelengths in the uv region (ε at 300 nm = 110 m^2 mol^{-1}). $S_2O_3^-$ reacts with $S_2O_3^{2-}$ forming the $S_4O_6^{3-}$ radical with a rate constant of 8×10^8 dm^3 mol^{-1} s^{-1}. The equilibrium constant of $S_4O_6^{3-} \rightleftharpoons S_2O_3^- + S_2O_3^{2-}$ was found to be less than 10^{-6} mol dm^{-3}. $S_4O_6^{3-}$ has an absorption maximum at 370 nm (ε = 165 m^2 mol^{-1}). The pK value of the protolytic equilibrium was found to be about 6.2. The molar conductivities of $S_2O_3^-$, $S_4O_6H^{2-}$ and $S_4O_6^{3-}$ have been determined. $S_4O_6^{3-}$ also is found by reduction of $S_4O_6^{2-}$ by e_{aq}^- and CO_2^-: $e_{aq}^- + S_4O_6^{2-} \rightarrow S_4O_6^{3-}$, and $CO_2^- + S_4O_6^{2-} \rightarrow CO_2 + S_4O_6^{3-}$. The $S_4O_6^{3-}$ radicals disappear by a second order reaction. The resulting products are polythionates. A mechanism of the consecutive reactions is proposed, in which the decomposition of hexathionate is catalysed by $S_2O_3^{2-}$ ions. (auth)

20835 LOW-TEMPERATURE RADIOLYSIS OF ORGANIC PHOSPHATES STUDIED BY ELECTRON SPIN RESONANCE. Haase, K. D.; Schulte-Frohlinde, D.; Kourim, P.; Vacek, K. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Phys. Chem.; 5: No. 4, 351-360(Jul 1973).

In the low-temperature radiolysis of organic phosphates (viz. trimethyl, triethyl, tri-n-propyl, triisopropyl, tri-n-butyl, and triphenyl phosphates), which was studied by electron spin resonance (ESR), dissociative attachment of the electron to the C—O bond occurs, resulting in the formation of the corresponding alkyl or aryl radical. The positive molecular ion abstracts hydrogen intra- or intermolecularly, depending on the structure of the ion, and produces another type of radical. Except in the case of triphenyl phosphate the structure of these radicals was derived from the ESR spectra; specifically deuterated tributyl phosphates give evidence of hydrogen being abstracted from the γ-position of the butyl group. In triisopropyl phosphate the rise of temperature results in the rearrangement of the free valence from the β to the α position of the isopropyl group. (auth)

20836 RADIATION SYNTHESIS OF HYDROGEN CYANIDE FROM NITROGEN–ETHYLENE SYSTEMS. Effect of Temperature, Gas Density, and Reactor Wall. Ikezoe, Y.; Sato, S.; Danno, A. (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 46: No. 4, 1154-1158(Apr 1973).

The rate of formation of hydrogen cyanide from the nitrogen–ethylene system by ^{60}Co gamma rays was found to depend on irradiation temperature, gas density, gas composition, and the nature of the wall surface of the reaction vessel. Above 100°C, the G(HCN) value increased with the rise of temperature. Below 100°C, the G(HCN) value remained constant down to −196°C. In the temperature range from 400 to −196°C, it increased with reduction of nitrogen gas density. The largest G(HCN) value obtained was 2.0. In certain cases, the wall surface influenced the suppression of hydrogen cyanide formation. As an active species responsible for hydrogen cyanide formation, excited nitrogen molecules are proposed in addition to nitrogen atoms. Excited molecules are decomposed to nitrogen atoms with small activation energy or deactivated by collision with other molecules. They play an important role in cyanide formation at low pressures and at high irradiation temperatures. (auth)

20837 RADIATION GRAFTING OF HYDROPHILIC MONOMERS ONTO POLYESTER. Choi, J. H.; Lee, C. K.; Lee, K. J. (Atomic

Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 103-114(Jun 1973).

Radiation grafting of acrylic acid and 4-vinylpyridine at room temperature was studied by an impregnation method to improve the hygroscopic properties, the antistatic behavior and the dyeability of polyester fabric. Polyester fabric was impregnated with acrylic acid or aqueous emulsion of acrylic acid–4-vinylpyridine by immersion at 25 or 70°C. The impregnated fabric was irradiated under nitrogen gas with γ radiation from ^{60}Co. When acrylic acid grafted polyester fabric was treated with sodium carbonate, calcium acetate, and potassium persulfate, the rate of water absorption was increased and most parts of polyacrylic acid formed were extracted off from the fabric with 0.1% solution of sodium hydroxide at 100°C. In the impregnation of a mixture of acrylic acid and 4-vinylpyridine the percent of grafting was shown to be proportional to the ratio of 4-VP/AA and radiation dose. Estimating by contact angle measurements of water on the various polymer surfaces, the antistatic behavior was decreased with the increase of grafting percent. Electron micrograph investigations disclosed the existence of certain type of discontinuities in the acrylic acid grafted polyester fiber which was treated with various salts. (auth)

20838 EFFECTS OF ADDITIVES ON THE RADIOLYSIS OF VITREOUS 3-METHYLPENTANE AT 77K. de Hollain, G. Louvain, Belg.; Univ. of Louvain (1973). 100p. (In French). Centre d'Etude de l'Energie Nucleaire, Mol, Belg.

Thesis.

3-Methylpentane, both pure and in the presence of 2-pentene or of carbon tetrachloride, was irradiated in the solid vitreous state at 77°K (2 Mrads). The yields of gaseous hydrocarbons, as congruent olefins and as condensation products, were measured by gas chromatography for concentrations of additives between 0 and 5 mole percent. The effect of oxygen on these yields was also determined. The yields of gases were decreased from 40 to 50% in the presence of 2-pentene (0.8 mole %); the variation reached 70% under the influence of CCl_4 (2 mole %). Kinetic analysis of these results and the study of the difference between the yields of saturated and unsaturated gases made it possible to interpret the effect of 2-pentene by a selective capture of the positive charge. The action of CCl_4 is twofold; it acts as an electron trap and as an acceptor of electron excitation energy. These methods of interference of the additives makes it possible to explain also the decreases observed for the yields of nongaseous products. (tr-auth)

20839 OVERLAPPING OF SPURS AND RADIATION YIELDS OF RADIOLYSIS. II. A Comparison of the Theoretical Effect of the Dose Rate of Irradiation on the Ratio of Radical to Molecular Radiation Yields with Experimental Results. Stolarczyk, L. (Inst. of Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 4, 293-296(May 1973).

A comparison of the theoretical equation, $G_R/G_M = (G^0_R/G^0_M)(1/1 + Z)$, for the title relation with the experimental data of Sutton and Rotblat [Nature, 180, 1332(1957)] has disclosed agreement for lower dose rates, up to 2×10^9 rads/sec (about 1.2×10^{23} eV ml^{-1} sec^{-1}), and discrepancy for higher values of the dose rate. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 20735, 20972, 21834, 21845, 21868, 21869, and 22933.

20840 (RLO-2227-T-14-11) NUCLEAR CHEMISTRY RESEARCH AT OREGON STATE UNIVERSITY. Annual Progress Report, 1972–1973. Thomas, T. D. (Oregon State Univ., Corvallis. Radiation Center). 15 May 1973. Contract AT(45-1)-2227. 65p. Dep. NTIS $5.25.

Abstracts of papers reporting completed research are presented, and research progress is reported in the following areas: photoelectron spectroscopy, Moessbauer spectroscopy, and development of apparatus. (DHM)

Hot-Atom Chemistry

20841 (COO-3570-8) RESEARCH ON HIGH-ENERGY CHEMICAL REACTIONS. Annual Report, Part I. Final Report on the Wolfgang Years. Cross, R. J. Jr. (Yale Univ., New Haven, Conn.). Jun 1973. Contract AT(11-1)-3570. 20p. Dep. NTIS $3.00.

A final report on the years, 1957 to 1972 is presented. This work covers five broad areas: nuclear chemistry, recoil tritium chemistry, the chemistry of hot halogen atoms, carbon atom chemistry, and molecular beams. Appendices give the complete bibliography and a list of students and postdoctoral fellows working on the contract. (JGB)

20842 RECOIL ^{82}Br REACTIONS WITH LIQUID CHLOROFLUOROCARBONS. Tominaga, T.; Iwata, R.; Makide, Y. (Tokyo Univ.). Bull. Chem. Soc. Jap.; 46: No. 6, 1882-1883(Jun 1973).

20843 KINETIC ISOTOPE EFFECT OF REACTIONS OF HOT HYDROGEN ATOMS IN MIXTURES OF GASES. II. Brodskii, A. M.; Temkin, A. Ya. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 1-3(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 3-6(1973).

The influence of the concentration of inhibitor on the rate of reactions of hot tritium atoms was calculated. The experimental results can be described satisfactorily using a resonance model proposed previously. (auth)

Properties of Radioactive Materials

Refer also to abstracts 20701, 20788, 21889, and 21908.

20844 (DP-MS-73-25) BIS(CYCLOOCTATETRAENYL) Np(III) AND Pu(III) COMPOUNDS. Karraker, D. G.; Stone, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1973. Contract AT(07-2)-1. 20p. (CONF-730807-5). Dep. NTIS $3.00.

From 166th American chemical society national meeting; Chicago, Illinois, USA (26 Aug 1973).

Potassium bis(cyclooctatetraenyl) neptunium(III) [$KNp(COT)_2$, COT = C_8H_8] and $KPu(COT)_2$ were prepared by reacting the trivalent actinide bromides or iodides with K_2COT in tetrahydrofuran (THF) solution. X-ray powder diffraction patterns indicate that these compounds are isostructural. The Moessbauer spectrum of the Np(III) compound has an isomer shift of +3.92 cm/sec (relative to $NpAl_2$), confirming a +3 valence with only slight covalency, and quadrupole splitting constant $eqQ/4 = 0.73$ cm/sec, demonstrating that the Np^{3+} ion has a site symmetry with a threefold or higher symmetry axis. Magnetic susceptibility measurements show $\mu_{eff} = 1.95\ \mu_B$ and $\theta = 11°$ for $KNp(COT)_2$, and $\mu_{eff} = 1.31\ \mu_B$, $\theta = 3.7°$ for $KPu(COT)_2$ for the temperature range 2.5 to 60°K. These results are interpreted as showing that the actinide(III) ions are in a symmetry site of lower than D_{8d} as in the analogous lanthanide(III) compounds or that the simple crystal field model is not applicable. These compounds are highly reactive to water and air, and oxidizing impurities easily produce $Np(COT)_2$. Repeated attempts to prepare $KU(COT)_2$ have been unsuccessful, with $U(COT)_2$ as the only product. (auth)

20845 (K-1842) APPLIED ULTRASONIC CLEANING AND POWDER DISPERSION. Lee, T.; Williams, J. W.; Weber, C. W. (Oak Ridge Gaseous Diffusion Plant, Tenn). 2 Aug 1973. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

The application of ultrasonics to a wide range of cleaning and powder dispersion requirements is demonstrated. With orientation toward understanding the applications discussed, a description of the equipment and a relatively simple treatment of the theory are included. In the sections describing the applications to cleaning and to powder dispersions, several innovations are included to provide uniform cleaning without erosion, multiple powder-sample dispersions, and tests for effective cleaning and for complete powder dispersion. The ultrasonic applications included cleaning small valve parts and large liquid centrifuge components, decontaminating simulated reactor fuel elements, and degreasing parts for subsequent plating. They also included dispersing powders for analytical and preparative purposes. (auth)

20846 (LBL-1666, pp 308-310) GROUP SEPARATIONS FOR SUPERHEAVY ELEMENTS. Kratz, J. V.; Liljenzin, J. O.; Silva, R. J.; Seaborg, G. T. May 1973.

In nuclear chemistry annual report, 1972.

20847 (MLM-2036) NUCLEAR PROPERTIES AND GENETIC RELATIONSHIPS OF THE NATURALLY OCCURRING RADIOACTIVE SERIES. Kirby, H. W. (Mound Lab., Miamisburg, Ohio). 15 Aug 1973. Contract AT-33-1-Gen-53. 50p. Dep. NTIS $4.00.

A report is presented that covers the basic principles of nuclear chemistry that the analytical chemist needs to know in order to perform his function. It is not intended for nuclear or radiochemists; the principal criteria for selection and treatment of material have been those of interest and utility to the analytical chemist confronted with the special problems inherent in the analysis of the naturally occurring radioactive series. (auth)

20848 (ORNL-4883, pp 85-86) SPECTROPHOTOMETRIC STUDIES OF SOLUTIONS OF LANTHANIDES AND ACTINIDES. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20849 ELECTROMOTIVE FORCE MEASUREMENTS ON FUSED $ThCl_4$ AND $ThCl_4$–KCl SYSTEMS. Yoshida, S.; Kuroda, T. (Tokyo Inst. of Tech.). Denki Kagaku; 41: No. 3, 217-220(Mar 1973). (In Japanese).

The fused $ThCl_4$–KCl system was investigated as a basic research toward the preparation of metallic Th by fused salt electrolysis and the reprocessing of nuclear fuels containing Th. The cell $Th_{(s)}/ThCl-KCl_{(l)}/Cl_{2(g)}$ was assembled and the electromotive force was measured at various $ThCl_4$ concentrations and temperatures. EMF of pure $ThCl_4$ was obtained as the function of the temperatures: $-E = 2.181 + 10.3 \times 10^{-4}\,(800 - t(°C)) \pm 0.05$ (volt). The cell reaction was supposed to be: $Th_{(s)} + 2Cl_{2(g)} = ThCl_{4(l)}$. Based on the comparison between the thermodynamic properties obtained from EMF measurement values and from phase diagrams, it was suggested that the complex ions $[ThCl_7]^{3-}$ and $[ThCl_5]^{1-}$ existed in the fused $ThCl_4$–KCl system. (auth)

20850 PROTACTINIUM(V) ETHOXIDE. Maddock, A. G.; Pires de Matos, A. (Chemical Labs., Cambridge, Eng.). Radiochim. Acta; 18: No. 2, 71-73(1972).

The preparation and some properties of protactinium(V) ethoxide are described. The extent of polymerization of the ethoxide in benzene solution is reported. The polymerization is confirmed by the infrared spectrum of the compound. (auth)

20851 STUDY OF OXIDES OF URANIUM IN THE REGION OF COMPOSITION $UO_{2.50}$–$UO_{2.67}$. Kovba, L. M.; Tsvigunov, A. N.; Kuz'micheva, E. U.; Komarevtseva, N. I. Sov. Radiochem. (Engl. Transl.); 14: No. 6, 965-966(1972).

Translated from Radiokhimiya; 14: No. 6, 921-923(1972).

Roentgenometric data obtained in the photography of single crystals of the oxides $UO_{2.50}$ to $UO_{2.67}$ were used to verify the existence of these compounds. The oxides were prepared by the reduction of α-U_3O_8 in hydrogen sulfide and the oxidation of δ-U_2O_5 in air. Phase compositions are compared. (JGB)

20852 INTERACTION OF SULFATE COMPLEXES OF URANYL WITH HYDROGEN PEROXIDE. II. Investigation of the Solid Phase in the System UO^{2+}–H_2O_2–SO^{2-}–H_2O. Radiochem (Engl. Transl.); 14: No. 6, 867-868(1972).

Translated from Radiokhimiya; 14: No. 6, 837-838(1972).

The conditions of synthesis of compounds in the solid phase in the system UO_2^{2+}–H_2O_2–SO_4^{2-}–H_2O were investigated. Results of chemical analysis of certain compounds that were isolated in pure form are presented. (JGB)

20853 IMPROVED SYNTHESIS OF DEUTERATED OLEFINS FROM THE WITTIG REACTION. Buchanan, G. W.; Gustafson, A. E. (Carleton Univ., Ottawa). J. Org. Chem.; 38: No. 16, 2910-2911(10 Aug 1973).

The synthesis of deuterated alkenes by the Wittig reaction is plagued by the occurrence of extensive deuterium scrambling and exchange with the reaction medium. In the preparation of deuterated o-divinylbenzene it is noted that a 20-fold increase in the product yield can be obtained with no apparent scrambling of deuterium via a simple modification of the decomposition procedure of the intermediate betaine. Addition of excess D_2O gives a 30% yield of deuterated o-divinylbenzene and 70% yield of deuterated vinylcyclohexane. If n-butyllithium is used as the base followed by D_2O workup, measurable exchange occurs at the exocyclic carbons in all compounds studied. (JGB)

20854 RADIOCHEMICAL DECOMPOSITION OF $N^{14}CH_3$ LABELED SPHINGOMYELIN. II. Petrovich, G.; Mumford, R.; Kanfer, J. N. (Eunice Kennedy Shriver Center, Waltham, MA). Chem. Phys. Lipids; 10: 149-151(1973).

Radiochemically pure N-$^{14}CH_3$-sphingomyelin was found to undergo decomposition to both choline-^{14}C and phosphorylcholine-^{14}C. (DHM)

20855 ELECTRODEPOSITION OF PROTACTINIUM AS FLUORIDE FROM ORGANIC SOLVENTS. Duschner, H.; Born, H. J.; Kim, J. I. (Technische Hochschule, Munich). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 433-436(Aug 1973).

An electrodeposition technique for the preparation of thin and uniform Pa-layers from organic solvents is described. The influences of solvents, electrode materials and applied high voltages on the deposition yield and the quality of the Pa-layer are investigated. A high resolution α-spectrum and a quantitative yield are obtained for Pa in isopropanol using an electropolished gold-sheet supported by copper plate on which a thin aluminum layer is deposited by evaporation. In this medium the anionic PaF_7^{3-} complex is deposited as $Al_3(PaF_7)_3$. (auth)

20856 PREPARATION OF METAL CARBONATES BY CO-PRESSURIZING ANHYDROUS METAL ACETATES. Head, E. L. (to United States Atomic Energy Commission). Australian Patent 426,165. 7 Jul 1972. Priority date 16 Mar 1967, United States of America (USA).

A method of forming metal carbonates is described that consists of pressurizing acetate solutions selected from a group consisting of the rare earth acetates, thorium acetate, uranyl acetate, and yttrium acetate in a carbon dioxide atmosphere, the improvement being the acetate is anhydrous. (auth)

20857 DITHIOLATES OF URANIUM(VI) AND URANIUM(IV). Extract. Zimmer, L. Darmstadt, Ger.; Technische Univ. (1972). 4p. (In German).

Thesis.

The coordination chemistry of the actinides was studied taking U(IV), U(VI), (as UO_2^{2+}), and Th(IV) as examples. New chelates with olefin dithiolates as ligands were prepared, particularly with sodium maleonitriledithiolates and its isomeric 1,1-dithiolate which show an uranium– sulfur coordination. The molecular structure was characterized by ir, uv and NMR spectroscopy. Moreover, the chemical stability of the uranyl chelates were proven with the result that all these complexes are labile against bases, the sulfur ligands are readily exchangeable if cations with an affinity to coordinate sulfur (e.g., Ag(I) and Ni(II) ions) are added, and the dithiolate rests are displaced by harder ligands such as carbonates and oxalates. (GE)

20858 DEVELOPMENT OF TECHNETIUM-99m LABELED 1-HYDROXY ETHYLIDENE-1,1-DISODIUM PHOSPHONATE FOR SKELETAL IMAGING. Callahan, R. J.; Castronovo, F. P. (Massachusetts General Hospital, Boston). Amer. J. Hosp. Pharm.; 30: No. 7, 614-617(Jul 1973).

From 7th annual ASHP midyear clinical meeting; Las Vegas, NV (4 Dec 1972).

The development of a radiopharmaceutical which may be used clinically for imaging the skeletal system is described. The disadvantages of early bone scanning agents are discussed. Procedures involved in the synthesis of 1-hydroxy-ethylidene-1, 1-disodium phosphonate (HEDSPA), the labeling of HEDSPA with ^{99m}Tc, and quality control of ^{99m}Tc HEDSPA are reviewed. Also discussed are experiments to determine the chemical form of ^{99m}Tc best suited for labeling with HEDSPA, and the biological assay of the new radiopharmaceutical. (auth)

Radioactive Waste Treatment

Refer also to abstracts 20758, 21081, 21082, and 22146.

20859 (BNWL-1761) RESEARCH AND DEVELOPMENT ACTIVITIES, WASTE FIXATION PROGRAM. Quarterly Progress Report, April–June 1973. Platt, A. M. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1973. Contract AT(45-1)-1830. 40p. Dep. NTIS $4.00.

A high-temperature (1400°C) melt for incorporating PW-6 waste calcine was developed which meets initial requirements for homogeneity, viscosity and glass leachability. The addition of zinc to the high silica glass substantially reduced the melt viscosity and at the same time improved the melt homogeneity. The glass leach rate appears to be slightly better than that of Pyrex glass. In fluidized bed calcination studies at ICPP, PW-6 high sodium waste was successfully calcined using a blend of PW-6 waste and stoichiometric quantities of aluminum nitrate. Runs based on substituting $Ca(NO_3)_2$ for $Al(NO_3)_3$ to form stable sodium compounds were unsuccessful. A spray calciner and continuous melter assembly has been built and will be used for nonradioactive development of a system for solidifying commercial-type high-level wastes. The leach rates of Rising Level Glass borosilicate glass core-drilled samples from WSEP PC-9 canister were 1 to 5×10^{-4} fraction of ^{137}Cs leached $(cm^2/g)^{-1}$ day^{-1}. This canister had been stored almost 2 years at a wall temperature above 390°C, and self-irradiated to a total dose in excess of 10^{11} R, yet the leach resistance of the product had not deteriorated significantly. A miniature eddy-current probe, which can be lowered into the WSEP canister thermowells, has been constructed and is being tested as a means of pinpointing areas of corrosion in the thermowells. Initial safety analysis evaluation efforts are associated with the evaluation of a reference system for the management of the high-level wastes arising from the chemical reprocessing of "spent" fuel elements. Currently, the reference waste management system, the modes for failure of the confinement barriers of this reference system, and the potential driving forces for release of radioactivity from the failed system are being defined. (auth)

20860 (BNWL-B-277) HIGH TEMPERATURE METHODS FOR DISPOSAL OF CONTAMINATED METAL EQUIPMENT. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1973. Contract AT(45-1)-2130. 47p. Dep. NTIS $4.50.

Three high temperature processes for simplifying the disposal of contaminated metal equipment were investigated: fused salt decontamination; metal meltdown under a fused inorganic slag; and metal meltdown under an inert atmosphere. It was found that contaminated stainless steel could be effectively decontaminated using oxidizing fused salts. Decontamination factors (DF's) of 10^6 or better were obtained using fused sodium nitrate at 800°C and several stages of fused salt-metal contact. The process generates a large volume of contaminated salt, however, which severely limits its practical application. Even using maximum salt recycle, a salt-to-metal weight ratio of 3 to 1 or greater is required to give a DF of 10^6. By melting down contaminated metal under a fused inorganic slag it was hoped that the radioactivity would be transferred to the slag phase, leaving a clean metal phase which could be cast into an ingot for uncontrolled reuse. It was found upon melting the metal that only a fraction of the activity was transferred to the fused slag, with the major portion remaining in the metal phase. When the metal phase solidified, the residual activity was dispersed throughout the metal in a nonleachable and nonsmearable form. The process simplifies equipment disposal by reducing the metal bulk volume to a minimum and effectively sealing the residual activity in the solidified metal. The process has the disadvantage of generating a substantial volume of contaminated inorganic slag which must be disposed of. By melting contaminated metal under an inert atmosphere it was hoped that the activity could be dispersed and fixed in the solidified metal. Experiments showed that, upon melting the metal, the bulk of the activity was retained in the metal phase while the remainder was vaporized or transferred to the crucible. Upon solidification of the metal, the residual activity was fixed in the metal phase in nonleachable form. Leaching tests with water and acids showed that the rate of pickup of activity by the leach solution corresponded approximately to the rate of metal corrosion. Thus metal meltdown under an inert atmosphere would simplify equipment disposal by consolidating the metal in a minimum volume and effectively sealing the residual activity in the metal phase. (auth)

20861 (CONF-730125-1) PRESENT AND FUTURE SITUATION OF NUCLEAR ENERGY. Production and Its Associated Industry: Normal Operation, Accident Prevention and Mitigation, Comparative Risk Assessment. Vinck, W. (European Communities, Brussels (Belgium). Commission). 12 Dec 1972. 105p. Dep. NTIS (U. S. Sales Only) $7.25.

The current status and future trends in nuclear power development in the Six Member States of the European Community are discussed within the frame of its enlargement to nine countries. The topics considered are: nuclear power forecasts, radioactive effluents from a growing nuclear industry; radioactive waste storage and accumulation or processing wastes; thermal waste from nuclear power production; accident potential, accident prevention and limitation of the possible consequences; and nuclear hazards in relation to other risks. (DHM)

20862 (ORNL-4883, pp 32-37) WASTE TREATMENT AND DISPOSAL. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20863 (ORNL-4883, pp 55-62) SEPARATIONS CHEMISTRY RESEARCH AND DEVELOPMENT. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20864 (ORNL-4883, pp 93-94) TRITIUM SEPARATION TECHNOLOGY. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20865 DESIGN OF AN INDUSTRIAL FACILITY FOR INCORPORATING FISSION PRODUCTS IN GLASSES AND THE STORING OF HIGHLY RADIOACTIVE GLASSES. Giraud, J. P.; Le Blaye, G. (Saint-Gobain Techniques Nouvelles, Courbevoie, France). Energ. Nucl. (Paris); 15: No. 1, 41-50(Jan 1973). (In French).

An industrial facility for incorporating fission products in glass (vitrification) is described. The principal basic hypotheses are presented together with the most important stages of the process used. A description is given of the arrangements adopted for the temporary storage of the fission product solutions, the principal vitrification unit, the processing of gaseous and ruthenium effluents, the temporary storage of glass on the site, and the general facilities available. The activities released are given together with an analysis of the design of the facility from the safety point of view. A brief indication is given of the investment costs. Applications of the process are summarized, emphasis being given to its contribution to safety problems associated with the short and long term storage of highly radioactive wastes. (FR)

20866 DEPOSITION OF FISSION PRODUCT IODINE ON INORGANIC FILTER MATERIALS FROM THE GASEOUS PHASE. Donner, C. Berlin; Technische Univ. (1972). 96p. (In German). Thesis.

Iodine-131-labeled CH_3I was used for the investigation of the deposition behavior of fission iodine in the form of methyl iodide on different filter materials. For this purpose, a special laboratory apparatus was developed. The charging of the adsorbent (molecular sieve of type X) with silver ions (Ag-LMS-X) and its influence on the effectivity of deposition was studied in particular. Gas chromatography and ir-spectroscopy are the methods applied for the identification of the reaction products obtained by chemisorption. In addition, the isotopic exchange with nonradioactive iodine in the pore system of the molecular sieve is studied. The single steps of the deposition process, i.e., diffusion, surface absorption and chemisorption, are discussed and a reaction scheme is developed. (GE)

20867 DISTRIBUTION OF RADIOACTIVE CERIUM BETWEEN THE VAPOR AND LIQUID PHASES ON EVAPORATION OF WATER SOLUTIONS. Chistyakov, A. D.; Bagretsov, V. F. At. Energ. (USSR); 33: No. 1, 573-574(Jul 1972). (In Russian).

This paper was summarized as paper No. 592/6390 with full copy held by TIC.

Since the purification of decontamination solutions is usually achieved by evaporation, there is a practical interest in the determination of possible limitations of the evaporation technique with respect to the purity of the vapor product. In the limit, the attainable vapor purity (with the absence of dropping removal) is determined by the coefficients of the physical-chemical distribution (K_p) of the substances between the vapor and liquid phases. The values of K_p depend on the nature of the substance, the composition of the solution which is evaporated, and the temperature. Studies were conducted on the dependence of K_p Ce(III) on the concentration of hydroxyl ions at the boiling temperature of water solutions (p = 1 atm). The studies indicated that, for the determination of the minimum values of K_p for cerium (and other rare-earth elements), a feasible evaporation results in an acid state. In this case, the coefficients of purity for the vapors of rare-earth elements can attain magnitudes greater than 10^8. (JGB)

20868 FLUIDIZED-BED DRYING AND CALCINATION OF NITRATE-PHOSPHATE SLURRIES. Yankin, G. D.; Shakhova, N. A.; Davydov, V. I.; Murav'ev, L. L. At. Energ. (USSR); 33: No. 2, 698(Aug 1972). (In Russian).

This paper was summarized as paper No. 599/6640 with full copy held by TIC.

Results of an investigation of the process of dewatering and calcination of nitrate-phosphate slurries simulating radioactive wastes, in a fluidized bed show that the drying and calcination process can be conducted at the following permissible ranges of variation in the process parameters: fluidized bed temperature t_{bed} = 350 to 420°C; flowspeed of fluidizing agent v = 0.8 to 1.3 m/sec; specific flowrate of atomizing air q = 0.3 to 0.75 kg/kg; total salts concentration in slurry C = 400 to 800 g/l; height of fixed bed H_{bed} = 0.16 to 0.3 m; average residence time $\tau_{av} \geq 3.0$ h. (DHM)

20869 REMOVING RADIOIODINE VALUES FROM A GASEOUS MEDIUM. (to United States Atomic Energy Commission). Australian Patent 417,903. 4 Nov 1971. Priority date 23 May 1967, United States of America (USA).

In environments where radioiodine values, particularly methyl iodide, are present or apt to be generated, suitable precautions should be exercised to prevent the escape of these values into the atmosphere. The problem of trapping or removing radioiodine values from gaseous atmospheres becomes even more difficult when the atmosphere is water saturated. It has been found that the contacting of gaseous, radioiodine bearing effluents with an aqueous solution of ammonium sulfide provides a highly satisfactory mechanism for trapping or removing the radioiodine from the effluent regardless of its water content. (auth)

20870 RADIOACTIVE WASTE DISPOSAL AND CLINICAL EMPLOYMENT OF RADIOISOTOPES. Spaziante, G.; Venturini, E.; Della Maggiore, U. Riv. Ital. Ig.; 31: No. 3-6, 165-182(1971). (In Italian).

Tests showed that some chemical substances are capable of increasing radioactive decontamination by concentrating the radioiodine present in a liquid. Tests demonstrated that silver nitrate and starch with activated coal can greatly reduce the radioactivity of the ^{131}I solution, keeping it either as insoluble salt ($Ag^{131}I$), when

silver nitrate has been used, or as a complex ion if starch has been used. Therefore it is practicably possible to considerably reduce the contamination of liquid wastes in hospitals. This may be done by treating the urine of patients undergoing a therapeutical course of ^{131}I, with $AgNO_3$ in such a quantity to bring the final concentration of $AgNO_3$ in the urine about to 0.1%. This strongly radioactive precipitate has to be retained until the spontaneous lowering of the radioactivity of ^{131}I. (auth)

20871 RECOVERY OF ACTINIDES AND FISSION PRODUCTS RELEVANT FOR APPLICATION FROM THE WASTE SOLUTION OF SPENT NUCLEAR FUELS BY MEANS OF COUNTER-CURRENT ION MIGRATION. Bilal, B. A.; Schwarz, B. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Radiochim. Acta; 18: No. 3, 148-150(1972). (In German).

The study is concerned with reprocessing of the waste solution of spent nuclear fuels by means of counter-current ion migration; it was conducted on a model mixture. The actinide elements Np, Am, and Cm and the fission products relevant for application were obtained in a relatively simple separation process. (auth)

20872 CONTROL OF RADIOIODINE RELEASE FROM REPROCESSING PLANTS. Bryant, P. M. (National Radiological Protection Board, Harwell, Eng.); Warner, B. F. pp 29-46 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

At fuel reprocessing plants the levels of ^{131}I can be significantly reduced by allowing it to decay before the decanning and reprocessing of the fuel. Further control is achieved at Windscale by monitoring stack emission for ^{131}I and by monitoring its critical path in the environment, i.e., to milk. A review is given of the experience gained in reprocessing Magnox fuel through the second Windscale reprocessing plant and DFR fast reactor fuel through the Dounreay reprocessing plant. The methods used to monitor the discharge and the environment are discussed and the principles used to calculate the derived working limits for ^{131}I and ^{129}I are given. Using this experience, an assessment is made of some of the problems likely to be met in the processing of short-cooled fast reactor fuel, with particular reference to gaseous and liquid effluents. (auth)

20873 INORGANIC ADSORBER MATERIALS FOR TRAPPING FISSION PRODUCT IODINE. Wilhelm, J. G.; Schuettelkopf, H. (Karlsruhe Nuclear Research Center, Ger.). pp 47-56 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

For the removal of fission product iodine at elevated temperatures and in oxidizing gases, inorganic, non-flammable adsorber materials should be used instead of charcoal. Experimental work was performed to evaluate the usefulness of inorganic adsorber materials for iodine-filtering devices. Special interest was concentrated on materials for off-gas cleaning in fuel reprocessing plants and gas cleaning inside the reactor containment under MCA conditions. In view of the high price of silver and the sensitivity of molecular sieves for acids, new inorganic adsorber materials were developed with relatively low silver loadings and high removal efficiencies for methyl iodide and iodine. Experimental data are given for the removal efficiencies of new inorganic adsorber materials in wet air and superheated steam. Experiments are reported to evaluate the effect of nitrogen oxides on the performance of the adsorber materials. The efficiencies and prices of the new materials are compared with those of silver-impregnated molecular sieves. (auth)

20874 TRAPPING OF RADIOACTIVE IODINE PRODUCED BY NUCLEAR POWER STATIONS: SAMPLING AND ANALYSIS EQUIPMENT; ON SITE CHECKING. Brion, J. (CEN, Fontenay-aux-Roses, France). pp 87-93 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

Particulate iodine and elemental gaseous iodine can be trapped by aerosol and activated coconut charcoal filters, but organic iodides are not effectively removed by such filters and are not dissolved in aqueous solutions. In humid air at temperatures from 25°C to 100°C the efficiency of iodine removal by charcoal can be increased by impregnation with triethylenediamine or potassium iodide. All adsorbents are subject to loss of efficiency upon aging and must be checked periodically. (auth)

20875 EXPERIMENTS AND EXPERIENCE WITH RADIOIODINE AT CHALK RIVER NUCLEAR LABORATORIES. Barry, P. J. (Chalk River Nuclear Lab., Ont.). pp 95-99 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

From the biological point of view, the various chemical forms of radioiodine are nearly equivalent, but they may behave quite differently toward media used to measure or control the levels of iodine contamination in air. Maypacks are useful for application in research to distinguish the chemical forms of iodine, and results are presented on studies of the absorption of iodine by copper screens used in the Maypack. However, practical monitoring for iodine requires a quicker and simpler sampling device. Chalk River Nuclear Laboratories (CRNL) have developed an automatic monitor sensitive to all forms of airborne iodine using charcoal-impregnated paper filters pretreated with elemental bromine; in such filters the efficiency for absorption of methyl iodine is greater than 99%. Radioiodine releases are controlled at CRNL by ventilating the reactor stack and cells through ducts equipped with commercially manufactured activated charcoal filters in addition to filters to remove particles. The average life of the charcoal filters is about nine months. (auth)

Radioisotope Production

Refer also to abstracts 21642, 21835, and 21888.

20876 (CEA-R-4470) OPERATING EXPERIENCE OF "PETRUS" FACILITY. Sontag, R.; Koehly, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1973. 36p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

In this shielded facility now in operation for a year and a half Np–Al and Pu–Al irradiated targets are chemically processed mainly in view of ^{238}Pu, ^{242}Pu, and ^{244}Cm recovery. The facility includes seven operating stations, five of which are specially aimed to chemical processing operations. The operating crew includes three teams of four people each, working on a shift basis and an 8 people day team, working during normal hours. Operating procedures and equipment performances are also described. (auth)

20877 (CONF-721091-, pp R5.b1-R5.b9) REACTOR ISOTOPES BEING PRODUCED IN SOUTH AFRICA. Fourie, P. J. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The facilities, procedures, and uses of radioisotopes in South Africa are reviewed. The basic policy of the Atomic Energy Board is: (a) to produce radioisotopes with a short half-life, for which a demand exists; (b) to produce radioisotopes for which there is a sufficiently large demand to make local production economical; (c) to manufacture cobalt-60 radiation sources for local use. (auth)

20878 (CONF-721091-, pp R33.b1-R33.b6) RADIOISOTOPES BEING PRODUCED WITH THE CYCLOTRONS OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH. Steyn, J. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The role of accelerators in South Africa as facilities for isotope production and the exclusive features of some of the accelerator-produced isotopes are discussed. Six carrier-free isotopes, viz. ^{7}Be, ^{22}Na, ^{55}Fe, ^{85}Sr, ^{109}Cd, and ^{139}Ce are now in regular production for the export market. Annual gross income from overseas sales is about R30,000 and the total exports since the programme started already amount to more than R182,000. All these isotopes are of course, also locally available in carrier-free chemically processed form. In 1970 the production of short-lived isotopes for local use was initiated. At present, ^{18}F, ^{52}Fe, ^{67}Ga, ^{123}I, ^{203}Pb, and ^{211}At are in regular production, mainly for use in the life sciences and more specifically for radiodiagnostic applications in South African hospitals. (DHM)

20879 (ORNL-4883, pp 38-44) TRANSURANIUM-ELEMENT PROCESSING. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20880 GENERATOR-PRODUCED RADIONUCLIDES IN CLINICAL PRACTICE AND THEIR CHEMICAL PROCESSING. Knie, B. (Bundesgesundheitsamt, Berlin). Roentgenpraxis; 26: No. 5, 106-114(1973). (In German).

A survey is given of the generator-produced radionuclides

which are used for diagnostic purposes in medicine. The essential advantages associated with their use are demonstrated. Moreover the disadvantages (which exist only conditionally) with respect to radiation safety and self-responsibility for the production of radiolabelled pharmaceuticals are described as well as the possibilities of reducing those disadvantages, e.g., by means of the application of hits. Two detailed descriptions of chemical preparations with generator-produced radionuclides show the working method as well as the expense involved. (GE)

20881 UTILIZATION OF COUNTER-CURRENT ION MIGRATION FOR SEPARATION OF ACTINIDES. Bilal, B. A.; Metscher, K.; Muehlig, B.; Reichmuth, C.; Schwarz, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Chem. Ing.-Tech.; 45: No. 12, 841-846(1973). (In German).

The method of counter-current ionic migration is proposed for the separation of actinides from highly active waste from the reprocessing of spent nuclear fuels and for the processing of irradiated transuranic targets, such as ^{237}Np, $^{241,245}Am$, ^{239}Pu, and ^{242}Pu, to obtain nuclides serving as energy and neutron sources. A universal separation process that seems to be suitable for these tasks and which makes use of the differences in ionic mobilities was developed on a laboratory scale and tested in cold operation. (GE)

Reactor Fuel Reprocessing

Refer also to abstracts 23437 and 23727.

20882 (CEA-CONF-2333) CONTRIBUTION OF HYBRID CALCULATION TO THE STUDIES OF NUCLEAR SAFETY OF EXTRACTIONS OF URANIUM AND OF PLUTONIUM. Case of Continuous Extraction Apparatus. Rouyer, H.; Merle, J. P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1973. 28p. (In French). (CONF-730460-1). Dep. NTIS (U. S. Sales Only) $3.50.

From international congress on the use of electron calculators in the field of chemistry; Paris, France (25 Apr 1973).

The characteristics of a pulsed column are recalled. A mathematical model is then established. This model leads to the resolution of partial differential equations with 2 independent variables which necessitates the utilization of a hybrid technique rather than traditional analogue methods which are too costly, because of the number of calculations involved. The program developed enables the concentrations of the three substances present (uranium, acid, and plutonium) to be followed after a disturbance to any of the input flows or concentrations. (FR)

20883 (DOCKET-50332-33) BARNWELL NUCLEAR FUEL PLANT. Order Extending Completion Date for CPCSF-4 from January 1, 1974 to December 31, 1976. (Allied-Gulf Nuclear Services, Barnwell, S. C.). 13 Aug 1973. 7p. Dep. NTIS $3.00.

20884 (JEN-265) GAS CHROMATOGRAPHIC ANALYSIS OF TRI-n-OCTYLPHOSPHINE OXIDE (TOPO) IN D2EHPA–TOPO–KEROSENE MIXTURES. Perez Garcia, M. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 11p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

A study about the minimum limit of TOPO, detectable by gas chromatography in an organic phase formed by D2EHPA and kerosene is carried out. The retention time and response factor under the same conditions are also studied. Octacosane was used as a reference hydrocarbon. (auth)

20885 (NP-19812, pp 1-22) IRRADIATED NUCLEAR FUEL REPROCESSING AT THE WINDSCALE WORKS OF BRITISH NUCLEAR FUELS LIMITED. Hughes, T. G. (British Nuclear Fuels, Ltd., Windscale, Eng.). May 1973.

The background for, and history of, the Windscale reprocessing works is described, beginning with the initial separation plant. Its development, manufacture, and commissioning are described, and some of the problems met with and their solutions presented. The modifications to the plant to meet the requirements of the civilian nuclear power programme in the late fifties are also dealt with, as are those changes which were necessary to reprocess oxide fuel from the AGR type reactors. Finally the development of methods for concentration and storage of high level fission products is described. (NO)

20886 (ORNL-4883) CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1973. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 122p. Dep. NTIS $5.45.

A separate entry was prepared for each section of the progress report. (DHM)

For abstracts of individual sections see: 20738, 20848, 20862–20864, 20879, 20887–20889, 21887–21889, 22129, and 24003.

20887 (ORNL-4883, pp 2-13) DEVELOPMENT OF METHODS FOR REPROCESSING HTGR FUELS. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20888 (ORNL-4883, pp 14-31) MOLTEN-SALT REACTOR PROCESSING. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

20889 (ORNL-4883, pp 95-99) MISCELLANEOUS PROGRAMS Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

Research progress is reported on the following programs: environmental impact of LWR nuclear power plants and the nuclear fuel cycle, resource studies, and control of emissions from fossil fueled plants. (DHM)

20890 PROBLEMS AND STATUS OF THE HTR FUEL CYCLE. Hackstein, K. G. (HOBEG mbh, Wolfgang, Ger.). Atomwirt., Atomtech.; 18: No. 6, 294-297(1973). ((In German).

Fuel elements for high-temperature reactors consist of graphite or of a graphite matrix in which spherical fuel particles are embedded. The focus of interest is on the uranium/thorium cycle since all prototypes now being built, such as THTR and Fort St. Vrain as well as the American large nuclear power stations with HTR, have this cycle. In view of the commercial introduction of the HTR which is now commencing, there are problems to be solved in closing the fuel cycle which are discussed in terms of the uranium–thorium cycle. The processes and individual stages in the reprocessing of HTR fuel elements are of particular interest and the status of their technology is described. (auth)

20891 SOLVED AND UNSOLVED PROBLEMS IN REPROCESSING. Uhde, W. (Technische Ueberwachungs-Verein Norddeutschland e.V., Hamburg). Atomwirt., Atomtech.; 18: No. 7, 335-337(1973). (In German).

From specialist's meeting of the group, Fuel Element and Fuel Cycle; Karlsruhe, Ger. (13 Nov 1972).

The sixth question of this series dealt with the solved and unsolved problems in the reprocessing of irradiated nuclear fuels. The situation with respect to fuel elements from light-water reactors differs from that of the elements from gas-cooled, high-temperature reactors. In the case of the LWR fuels the problems mainly lie in the further development of already available techniques to meet the needs of future large installations. Here, the high burn-ups of 20,000 MWd/t (and eventually over 30,000 MWd/t) as compared with the 2,000 to 3,000 MWd/t of the GGR fuels, will considerably increase the difficulties. The reprocessing of HTR fuel elements is still in the research phase, not least because of the still high costs. A large plant will not be needed before the end of the eighties and in all cases the technical problems are known and are soluble. (auth)

20892 DECLADDING ZIRCONIUM CLAD NUCLEAR FUEL ELEMENTS. Bartlett, C. B.; Wirsing, E. Jr.; Hatch, L. P. (to United States Atomic Energy Commission). Australian Patent 416,396. 11 Aug 1971. Priority date 11 Feb 1966, United States of America (USA).

A process for recovering uranium from zirconium clad fuel elements is described that comprises decladding the element in a fluidized bed of inert particles using a gaseous stream made up of from 20 to 90 vol % oxygen and 10 to 80 vol % hydrogen fluoride having a temperature of from 500 to 800°C, and the exposed uranium is then reacted with fluorine at a temperature ranging between 400 to 450°C. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 21392, 21446, 22728, 23175, 23508, 23567, 23569, 23571, 23836, and 23899.

20893 (AD-748216) PRACTICAL ASPECTS OF FUNDAMENTAL RESEARCH IN THERMIONIC CONVERSION. Final Technical Report, 1 November 1971–30 Jun 1972. Rasor, N. S.; Britt, E. J. 31 Aug 1971. Contract N00014-70-C-0252. 71p. (NSR-1-4). NTIS.

The results in a continuing effort to use basic converter research for practical improvement of thermionic conversion systems are summarized. In the reporting period, pulse-enhancement experiments previously reported for argon were repeated using xenon. The results confirm the theoretical analysis, i:e., decay times are twice as long in xenon and pulse power requirements less than half those in argon. By adding cesium vapor at low pressure to lower the collector work function, both the argon and xenon pulse-enhanced diodes were operated with significant output power at 1200 to 1300°K. Pulse input power for xenon was less than 20% of the output power. (auth)

20894 (AD-756489) EXPERIMENTAL AND ANALYTICAL RESEARCH ON A TWO MEGAWATT, HIGH PERFORMANCE MHD GENERATOR. Interim Report, 1 April 1971–1 October 1972. Sonju, O. K.; Teno, J. (Avco-Everett Research Lab., Everett, Mass). Oct 1972. Contract F33615-71-C-1456. 340p. (AFAPL-TR-72-98). NTIS.

The initial results are presented of a combined analytical and experimental program whose broad objectives are to achieve a more complete understanding of the operation and appropriate design techniques of compact high-performance MHD generators. A detailed analytical basis of the performance of these generators and a demonstration of the feasibility of operating compact high-performance MHD generators under a repetitively pulsed mode of operation at high power levels—in this case at the 2 MW level are presented. In particular, the results, of studies of stability, and effects, transient response, diagnostic, rapid startup, channel voltage breakdown and performance optimization are discussed and summarized. A parallel effort under this program has been directed to constructing a generator test facility and designing and fabricating a 2 MW high-performance MHD generator system to be used in the test facility. (auth)

20895 (MLM-1982) BIFOLD NUCLEAR POWER SOURCE. Wolfe, R. A.; Stubbins, W. F. (Mound Lab., Miamisburg, Ohio). 15 Aug 1973. Contract AT(33-1)-Gen-53. 195p. Dep. NTIS $7.60.

The BIFOLD Nuclear Power Source, whose name denotes two distinctly different means of energy release in a single device, joins SNAP isotopic heat source and SNAP reactor technology to provide reliable uninterruptable base power which is augmented during periods of high demand power by operation in a critical reactor mode. The fuel, ^{238}Pu, is an alpha emitting heat source isotope which is able to form a small critical system. BIFOLD is a small, compact power source using heat pipes with thermoelectric or other energy converting components operating in an isothermal state at its base power of 11 kW(t) to 200 kW(t) or more to meet demand power needs. The split core of BIFOLD permits all operational tests to be completed economically with zero-power reactor operation which avoids induced radioactivity in components and the build-up of fission fragment inventory. Detailed reactor analyses were made of various configurations of fuel, reflector, heat removal penetrations, controls, and so forth, to yield critical masses and lifetimes. The thermal analyses consider temperature profiles, heat removal requirements, consequences of the failure of a heat pipe, temperature limits and the match of the heat production and its removal to the electrical conversion system. In this study, specific thermoelectric elements govern the temperature ranges and are reflected in the reported characteristics of the BIFOLD source. The BIFOLD concept couples equally well to Rankine cycle or Brayton cycle power conversion systems or to thermionic generators. Nineteen hexagonal fuel elements containing ^{238}Pu form a hexagonal core of approximately 27.5 kg of PuO_2 as plutonia–molybdenum cermet (PMC). The core is cooled by 19 individual gas-controlled heat pipes containing potassium, one in each fuel element. A number of different fuel forms were considered in the nuclear and thermal analyses. Production grade plutonium (80% ^{238}Pu, 16% ^{239}Pu, 4% other plutonium isotopes) as an oxide, PuO_2, and as plutonia–molybdenum cermet (PMC) are found suitable. The former has a smaller critical mass but restricts the power ranges owing to its lower thermal conductivity than the latter. The engineering studies indicate that both the minimum and maximum power ranges can be varied and depend upon the isotopic mix of the ^{238}Pu in the core and the heat removal capability. The lifetime of BIFOLD is 5 to 25 years depending upon the duty cycle, power level, and excess reactivity and is thought to be limited by non-nuclear components. The BIFOLD configuration is directly applicable to compact reactors using other fast reactor fuels in which the base power is surrendered. The thermal profile studies show that the maximum core temperature for the design power range, base power of 11 kW(t) to 200 kW(t), remains well below the fuel melting temperature even in the event of the failure of a few heat pipes or thermal sinks. An extension of demand power up to one half a megawatt is shown to be practical with larger diameter heat pipes to increase the heat removal rates and a corresponding increase in critical mass. The BIFOLD source eliminates the need to "over-design" isotopic heat sources and "under-design" reactors to meet the specific power demands. (auth)

20896 (SFB-MHD-8) INVESTIGATION OF THE ACCELERATOR NOZZLE IN THE MHD-CONDENSER PROCESS AND COMPARISON OF DIFFERENT PROCESS OPERATIONS. Freund, J. (Technische Universitaet, Berlin (West Germany)). Jun 1972. 182p. (In German). Dep. NTIS (U. S. Sales Only) $11.25.

Some processes were investigated for the one-component condenser cycle of magnetohydrodynamic energy conversion with potassium as the working medium. These included two different ways of liquid preheating and a third method with an additional pre-separation of vapor. A main item was the investigation of the nozzle. Wall friction, acceleration of two groups of droplets with different mean diameter, droplet disintegration, and heat removal from the expanding two-phase stream were taken into account. The results showed decreasing nozzle efficiency due to increasing length and heat removal. The nozzle performance strongly determined the efficiency of the cycle without regard of the generator. Its value increased with longer nozzles. It reaches maximum values for inlet vapor qualities of about 5 to 10%. The values of different losses are estimated. (auth)

20897 (WANL-3043-1) EVALUATION OF PRACTICABILITY OF A RADIOISOTOPE THERMAL CONVERTER FOR AN ARTIFICIAL HEART DEVICE. Phase I, Final Report, April 1971–November 1971. (Westinghouse Electric Corp., Pittsburgh, PA. Astronuclear Lab.). Aug 1973. Contract AT(11-1)-3043. 400p. Dep. NTIS $10.60.

The results of Phase I of the Evaluation of Practicability of a Radioisotope Thermal Converter for an Artificial Heart Device are reported. The overall objective of this two phase program is the determination of practicability of developing a compact radioisotope thermal converter having minimum weight and volume and a minimum life of ten years. In this context, the thermal converter is the device by which thermal energy from a radioisotope heat source is converted to another energy form suitable for pumping blood. The Phase I objectives were: the evaluation of innovative concepts for a variable powered thermal converter incorporating a vented radioisotope capsule heat source, and the recommendation of the most promising concept for Phase II practicability assessment. As a conclusion of the Phase I study, a Stirling cycle power source providing pulsatile input to a blood pump diaphragm by means of a mechanical drive train was recommended for further Phase II evaluation. This selection was made from eight final candidates which had been screened from about two dozen concepts investigated. These investigations included static conversion devices as well as dynamic devices representing several different thermodynamic approaches. Cascaded thermoelectric, Stirling cycle gas dynamic, and vapor cycle dynamic power conversion concepts were included in the eight contending concepts. Mechanical drive, direct hydraulic drive, and accumulator hydraulic drive were considered as methods for transforming and transferring the power source output to pulsatile operation of the blood pump. (auth)

20898 (WANL-PR(EEE)-55) COMPACT THERMOELECTRIC CONVERTER SYSTEMS TECHNOLOGY. Final Report. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Jun 1973. Contract AT(04-3) 701. 455p. (NASA-CR-121210). Dep. NTIS $24.75.

Work on the development of the tubular thermoelectric module is described. During the period from July 1965 to June 1969, research on the Compact Thermoelectric Converter Program with the fundamental objectives to develop and demonstrate a tubular thermoelectric module of good performance, long life, and high reliability, for application with either reactor or iso-

tope heat sources is summarized. During the period from October 1967 through June 1973, the further development of the tubular module has been accomplished on the Compact Thermoelectric Converter System Technology Program and has been directed specifically at application with the zirconium hydride reactor. The effort under the earlier Compact Converter Program has been reported earlier. This final report under the System Technology Program describes only the efforts of the more recent program. (TFD)

20899 (WANL-TME-1906-A) AN UPDATE OF INPUT INSTRUCTIONS TO TEMOD. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). 18 Jun 1973. 91p. (NASA-CR-121225). Dep. NTIS $6.75.

The theory and operation of a FORTRAN IV computer code, designated as TEMOD, used to calculate tubular thermoelectric generator performance is described in WANL-TME-1906. The original version of TEMOD was developed in 1969. This report which is written as Appendix D of WANL-TME-1906, describes additions to the mathematical model and an update of the input instructions to the code which have been developed in the period 1969 to 1973. Although the basic mathematical model described in WANL-TME-1906 has remained unchanged, a substantial number of input/output options have been added to allow completion of module performance parametrics. The report, then, basically replaces Section IV of WANL-TME-1906 entitled "Input to the TEMOD Code." A FORTRAN listing of the code is included. (auth)

20900 THEORY AND PERFORMANCE OF A TRITIUM BATTERY FOR THE MICROWATT RANGE. Braun, J.; Fermvik, L.; Stenbaeck, A. (Aktiebolaget Atomenergi, Studsvik, Sweden). Phys., E (London); 6: No. 8, 727-731(Aug 1973).

In certain battery applications, e.g., energizing tiny electrostatic oscillators useful for timepieces, the power needed is very modest (about 0.5 to 1.5 μW) but the output voltage must be high (500 to 1500 V) and a long lifetime is desirable. These requirements can be met by an isotopic battery, based on the collection of charged particles emitted from a tritium source. The report describes the theory and present state of development of such a battery, mechanically designed to fit into the case of a wristwatch. (auth)

20901 7TH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, SAN DIEGO, CALIFORNIA, SEPTEMBER 25–29, 1972. Washington, DC; American Chemical Society (1972). 1543p. (CONF-720925-).

Two-hundred-nineteen papers were presented at the conference. A separate abstract was prepared for each of 97. The remaining 122 papers dealing with advanced energy concepts, fuel cell technology, chemical battery technology, electrochemical energy conversion systems for biomedical uses, and advanced automotive applications were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 20904–20965, 21392, 23223–23226, 23454, 23508, 23567–23571, and 23835–23857.

20902 OPTIMIZATION OF FARADAY MHD GENERATOR DUCT. Umoto, J.; Yoshida, M. (Oyoto Univ., Suita, Japan). Mem. Fac. Eng., Kyoto Univ.; 34: No. 4, 359-372(Oct 1972).

For the purpose of contributing to the optimum design of the Faraday MHD generator duct, a numerical calculation is derived from the basic quasi one-dimensional MHD equations of the diverging rectangular duct and the integrals which express duct size, e.g., length, surface area or volume. The calculation is intended to minimize the integrals under the condition of extracting a required output power from the duct, when the applied magnetic flux density, the mass flow rate and the duct inlet or outlet total pressure and temperature of the working gas are held constant. (auth)

20903 FIZICHESKIE OSNOVY TERMOEMISSIONNOGO PREOBRAZOVANIYA ENERGII. (Physical Bases of Thermoemission Energy Conversion). Smakhanov, I. P. (ed.). Moscow; Atomizdat (1972). 374p.

A large number of published works in the last 10 to 15 years on the physical processes in the low-temperature weakly ionized plasma have been caused by the practical needs for the creation of large effective sources of electrical energy. The structure of layers adjacent to an electrode in the plasma, the mechanism of the ionization of atoms in discharges, questions of the stability and the origin of oscillations in weakly ionized plasma are examined. Methods are reported for the calculation of the volt-amp characteristics of gaseous discharge and calculation of the kinetic coefficients of low-temperature tri-component plasmas in a magnetic field. Special attention is given to the investigation of low-voltage arc discharge. The effect of different admixtures to the cesium on the work of the thermoemission energy conversion is also examined. (tr-auth)

20904 ROOM TEMPERATURE ELECTRICAL PROPERTIES AND DOPANT PRECIPITATION FOR SiGe THERMOELECTRIC ALLOYS. Nasby, R. D.; Burgess, E. L. (Sandia Labs., Albuquerque, NM). pp 130-136 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Room temperature electrical resistivity and Seebeck coefficients are reported for 80 at. % Si, hot pressed alloys as a function of carrier concentration from 10^{18} to 10^{20} cm^{-3}. For p-type alloys, Hall mobilities are presented and Hall coefficient data are compared with chemical determinations of the boron dopant content to obtain the Hall factor. Precipitation of the phosphorus and boron dopants which leads to performance degradation is discussed. Results of applying the model of Lifshitz and Slyozov to phosphorus precipitation for prediction of resistivity data obtained from a long term anneal are given. (auth)

20905 SILICON-GERMANIUM TECHNOLOGY PROGRAM OF THE JET PROPULSION LABORATORY. de Winter, F.; Stapfer, G. (California Inst. of Tech., Pasadena). pp 137-148 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The outer planetary exploration missions studied by the Jet Propulsion Laboratory require silicon-germanium Radioisotope Thermoelectric Generators (RTGs) in which the factors of safety are as low as is compatible with the reliable satisfaction of the power needs. It is undesirable to have either excessive weight or insufficient power. The Jet Propulsion Laboratory has had an active program in silicon germanium technology for the past several years, aimed at developing the understanding which will allow the characteristics of SiGe RTSs to be predicted accurately. Work on silicon-germanium sublimation is presented. Analytical modeling work on the solid-diffusion process involved in the steady-state (free) sublimation of silicon-germanium is described. Analytical predictions are made of the sublimation suppression which can be achieved by using a cover gas. A series of accelerated (high temperature) tests which were performed on simulated hardware (using 4 SiGe couples) to study long term sublimation and reaction mechanisms are also discussed. (auth)

20906 THERMOELECTRIC GENERATOR TEST PROGRAM AT JPL. Stapfer, G.; Rouklove, P. (California Inst. of Tech., Pasadena). pp 149-158 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

As part of an overall thermoelectric generator evaluation program, a number of units are being life tested. Whenever practical, these tests are conducted to closely simulate conditions which are prevalent during an actual spaceflight. The test results and analysis performed on data obtained from eight generators exhibiting a total combined operating time of about 21 years are discussed. Three SNAP-19 type generators are described. Generator SN-20, the engineering model of the units presently operating on the Nimbus S/C, has been in operation for over 4 years and has shown drastic degradation after losing the internal cover gas. Generator SN-21, with more than four years of operating time, is operated in an air environment. The performance of this generator appears predictable and stable. For the last 2 years of operation generator degradation has been negligible. Generator SN-31, which utilizes the TAGS material for the "P" thermoelectric leg, is similar in design to the units to be used on the Pioneer S/C and has operated for over two years in an all-argon atmosphere. The analysis of the data was used to predict the performance of this type generator for extended periods of time. A SNAP-27 (Mod-15) generator (engineering model for APOLLO) has accumulated almost three years of operating time. Although the degradation rate of this generator is very slight, it appears that the generator is sensitive to thermal cycling. The results of a tubular lead-telluride module (TEM-10) operating for more than one year are discussed. Some of the results indicate material migration as a degradation mechanism. The degradation of a SNAP-11 (QN-3) generator which has operated for five years indicate an extremely small rate of degradation during the latter portion of the testing. Stabilization of the generator output is attributed to the fact that the internal gas pressure has been maintained. A silicon-germanium generator (Reference Gen-

erator) using the 63% Si–37% Ge alloy has been operating for approximately two years. The generator performance is compared with the performance predicted by a degradation model which assumes only dopant precipitation. Since the operating temperatures of this generator are maintained below 1000°C, any sublimation degradation effects should be minimum within this time period. (auth)

20907 VAPORIZATION AND COMPATIBILITY OF SiGe RADIOISOTOPE THERMOELECTRIC GENERATORS. Staley, H. G.; Rovner, L. H.; Snowden, D.; Elsner, N. B. (Gulf General Atomic Co., San Diego, CA). pp 159-167 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The limiting operating temperatures of SiGe thermoelectrics designed for extended operation are set by sublimation process of the elements and by considerations of their compatibility with the surrounding insulating elements. Mass spectrometric Knudsen cell and Langmuir vaporization modes of operation have been utilized in the study of the equilibrium vapor species and in the time evaluation of the sublimation process. Isothermal, high vacuum (10^{-9} torr) anneals of samples have extended observations to long time spans. The time variations follow the formation of surface depletion layers due to disproportional rates of sublimation of the various species. Interactions of thermocouple elements with quartz and other materials have been tested in a variety of ways. The potential for quite drastic reactions in unfavorable situations has been amply demonstrated. (auth)

20908 DOPANT PRECIPITATION IN SILICON–GERMANIUM ALLOYS. Raag, V. (Resalab, Inc., Sunnyvale, CA). pp 168-173 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The model commonly used to describe dopant precipitation in Si–Ge alloys is discussed. The results of an experimental program are fit to the model in order to determine the long-term behavior of the thermoelectric properties of the n-type 80 at. % Si–20 at. % Ge alloy. Thermoelectric property projections to twelve years of operating time are given. (auth)

20909 MODEL TO PREDICT THE DEGRADATION OF A SiGe THERMOPILE. Stapfer, G.; Truscello, V. (California Inst. of Tech., Pasadena). pp 174-179 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The successful utilization of a Radioisotope Thermoelectric Generator (RTG) as a power source for space flight missions requires that the available output power from such a device be predictable throughout the mission. For this purpose a model capable of predicting the available output power of an RTG utilizing silicon–germanium thermoelectric elements has been developed. The various phenomena which affect the available output power of a typical RTG are discussed and estimates of the magnitude of these effects given. Power degradation as well as the corresponding changes in operating temperature are calculated by means of a computer code which systematically accounts for the time and temperature-dependent variables. The model includes changes in performance due to fuel decay, alteration of bulk thermoelectric properties, changes in electrode contacts, geometry changes due to material sublimation, and degradation of the thermal insulation. (auth)

20910 PERFORMANCE OF A ^{60}C-FUELED TUBULAR THERMOELECTRIC GENERATOR. Rose, C. M.; VanBibber, E. V. (Westinghouse Astronuclear Lab., Large, PA). pp 180-185 of 7th Intersociety Energy Conversion Engineering Conference. Washington; (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A radioisotope thermoelectric generator was fueled with 183,000 Curies of high-activity ^{60}Co fuel on Feb. 15, 1971. Except for the addition of cooling finned surfaces which were attached to the radiation shield after approximately 1,000 hours of testing, the unit has run essentially unattended at the Savannah River Laboratory since being fueled. The RTG employs a compact tubular thermoelectric converter. Performance data from the RTG system are discussed. A correlation between calculations and beginning of life test data indicates that the mathematical model for this configuration, in which a sizeable portion of the gamma energy is attenuated within the thermoelectric elements, is adequate. These results justify the use of the code in performing future parametric studies to identify an optimum module size for centerline fueling with cobalt. Evaluation of substantial endurance test data, which are presented, indicate that gamma attenuation also has no effects on module performance stability (i.e., degradation rates). This determination was made by separating the effects of module degradation from those of gamma fuel decay thus affording a comparison with existing module performance stability data generated under controlled, constant temperature, operation. (auth)

20911 LONG TERM TESTS OF A SNAP-19 THERMOELECTRIC GENERATOR. Rouklove, P.; Truscello, V. (California Inst. for Tech., Pasadena). pp 186-193 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The results of tests performed at JPL on a SNAP 19 thermoelectric generator, SN-20, are presented. The generator was assembled with 90 couples of 2N–3P composition connected in three parallel rows. It was similar to the two generators (SN-24 and 25) which were flown on the Nimbus III observation spacecraft launched April 14, 1969, and which operated until January 22, 1972. The SN-20 generator was tested for approximately 37,000 hours using electrical heating to simulate the heat released by isotope decay. The tests included parametric evaluations, special tests to simulate launch and orbit conditions and a long term life test in both vacuum and argon environments. After 27,000 hours of operation the output power from the generator decreased to approximately ½ of the beginning of life value while the internal resistance increased by a factor of 5. Analysis of the test results, confirmed by preliminary metallographic examination, indicated that the output power degradation was the result of excessive sublimation of the thermoelectric material and loss of the hot junction bond due to the depletion of the internal cover gas. This also resulted in excessive junction temperatures. Comparison is made with the behavior observed from the two flight generators and a tentative conclusion is advanced as to the reason for their failure. (auth)

20912 HYBRID TE PANEL TEST RESULTS. Bifano, J. E. (Lewis Research Center, Cleveland). pp 194-199 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Test results are presented for a nine couple (3 × 3 array) thermoelectric panel of hybrid thermocouples. In the hybrid couple, a hollow cylinder of p-type Si–Ge is used to encapsulate a segmented PbTe/Si–Ge n-leg. The hybrid couple is predicted to offer a 10- to 15-% improvement in performance relative to all Si–Ge couples. The efficiency, output power, and internal resistance of the panel as well as the resistances of the individual hybrid couples are presented as a function of test time covering a period of more than 2600 hours. Initial test results indicated hybrid couple performance consistent with design predictions. Extraneous resistance ranged from 20 to 25% of the hybrid couple thermoelectric resistance. During the first 600 hours of operation, the degradation rate observed was close to that predicted; however, at that time, the heater failed causing a thermal cycle. An increase in both degradation rate and rate of change of couple resistance was observed following the thermal cycle, and, at 1100 hours, erratic performance of one couple was noted, indicating a partial bond failure. The 10 to 15% improvement over all Si–Ge couples, demonstrated initially by the hybrid couple, was offset by the high resistance that developed following the thermal cycle after 600 hours of testing. (auth)

20913 DESCRIPTION AND STATUS OF THE TRANSIT THERMOELECTRIC CONVERTER. Bradshaw, G. (Gulf General Atomic Co., San Diego, CA); Postula, F.; Hagis, W. pp 200-215 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The TRANSIT RTG, the first five-year-life-time thermoelectric converter developed by the USAEC, is to be used as the primary power source on the U. S. Navy's TRANSIT Navigational Satellite. Designed to deliver a minimum end-of-mission electrical power of 30-W in five years, the converter uses lightweight lead telluride thermoelectric panels which operate at low hot side temperatures (400°C) in a vacuum environment, thereby providing in-

creased reliability over systems requiring a cover gas to inhibit thermoelectric material sublimation. Development, qualification, and production of the TRANSIT converter was completed in Nov. 1971 and the first flight unit converter (F1) was delivered. The converter and the qualification program are described. Performance data on the F1 converter during acceptance tests and on major life test hardware are presented. Current 5-y performance predictions are discussed. The integration and performance of the converter with the TRANSIT satellite are reviewed. A brief review of the growth status of the TRANSIT and Isotec thermoelectric technology is also presented. (auth)

20914 THIN FILM THERMOELECTRIC GENERATORS. Collier, R. K.; Backus, C. E. (Arizona State Univ., Tempe). pp 216-220 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Work directed toward the development of dc power supplies that are very small in physical size but that are capable of large voltage outputs is reported. Present thermoelectric generators are prohibitively large for some applications and impractical for large voltages. A scheme is investigated which would utilize vacuum deposited thin films to make thousands of thermoelectric cells in a very small volume. The idea is to deposit thermoelectric materials and insulators onto a thin substrate to create a multistage thermoelectric generator in which the legs are deposited on top of one another. Theoretical calculations show that the thermal efficiency is reduced by only about 1% relative to a conventional generator assuming that 10 thermoelectric junctions are deposited on a single substrate. If only one junction is possible, the efficiency is about one-half that of conventional generators. To investigate the technical feasibility of this thin film concept, elemental materials were chosen for deposition. Bismuth and antimony were used to insure a relatively large thermoelectric effect, and silicon monoxide was used as the insulator. The experimental results showed that electrical properties such as resistivity and Seebeck coefficient of the thin films agreed to within 10 to 20% of the properties of the bulk materials. However, only generators of a single cell were successful due to problems with the insulating layers between thermoelectric elements. These problems were "pinholing" and excessively heating the deposited bismuth layer with the heat from the insulator evaporation source. The pinholes in the insulating layer could be open circuited by discharging a capacitor through them, but the later problem prevented obtaining successful multicell deposits. This is thought to be a problem with bismuth rather than the concept. (auth)

20915 COMPUTER PROGRAM FOR THE TRANSIENT ANALYSIS OF RADIOISOTOPE THERMOELECTRIC GENERATORS. Eggers, P. E.; Ridihalgh, J. L. (Battelle Columbus Labs., OH). pp 221-227 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

This computer program represents a comprehensive analytical tool providing the capability for predicting the output power and temperature profile of an arbitrary radioisotope thermoelectric generator (RTG) design in the presence of time-dependent operating conditions. The approach taken involves the merging of three existing computer programs, i.e., an RTG weight optimization design program, a thermoelectric analysis program, and a nodal heat-transfer computer program. A total of seven transient conditions are included in the computer program as the principal transients affecting long- and short-term performance characteristics of RTGs. This computer program is unique in that it designs an optimum RTG, generates a thermal model or analog and performs heat transfer analysis of the RTG under user specified transient conditions. (auth)

20916 TRANSIENT BEHAVIOR OF MULTISTAGE THERMOELECTRIC COOLERS. Hoyos, G.; Rao, K. R. (Univ. of Texas, Arlington). pp 228-234 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The fast transient response of multistage thermoelectric (TE) coolers under pulse-on-pulse drive current is described. A two-stage cooler operating under temperature equilibrium conditions with each stage separately excited by corresponding optimum dc current designed for maximum steady state cooling is suddenly subjected to a square current pulse. Both the amplitude and duration of the pulse are varied to maximize the super cooling effect. To minimize heat convection and condensation loading on the cooler, the experimental investigation was conducted in vacuum at about 10^{-4} torr. Electronic circuitry for generating current pulses of variable amplitude and width and for sensing and recording the temperature transients is described. Driving the bottom and top stages of the cooler at 3.15 A and 3.25 A dc respectively yielded the maximum steady-state cooling. The increased super cooling (over and above the steady-state value) was about 8°C, with a square pulse of current of 25 A amplitude and width of 600 ms. The recovery time (on removal of the pulse) for the cold junction temperature to return to within 0.1°C of the steady state value was 40 s. This experimental research showed that additional transient cooling of cascaded TE coolers can be obtained by pulse-on-pulse drive current. (auth)

20917 STUDY OF THE FAST TRANSIENT BEHAVIOR OF PULSED THERMOELECTRIC COOLERS. Field, R. L. (Norfolk Naval Shipyard, Portsmouth, VA); Blum, H. A.; Bywaters, R. P. pp 235-240 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Experimental, high speed temperature response data were taken on a single stage thermoelectric cooler as it was subjected to a high current, short duration, rectangular dc pulse. The pulse was imposed on the cooler as it was operating in its optimum, steady-state, cooled-down condition. The cooler attained steady-state temperatures of about −40°C with the hot junction at 27°C. Pulse cooling down to about −65°C was obtained with many combinations of current and pulse duration. Typical pulse current and duration were 10 A for 30 ms. The pulse could be repeated about every 15 s. Average figure-of-merit of cooler materials, bismuth and antimony tellurides, was 2.69×10^{-3} K^{-1} at 3°C. The cooler was of a practical, common size and configuration, being two elements, standing side-by-side, connected to the top with a very thin silver bus bar. Element cross-sectional area was 0.00145 cm^2 and element height was 0.5 cm. Every effort was made to reduce the mass of the bus bar, solder, and thermocouple which was used to measure the temperature. Good correlation was obtained between the experimental data and a computer model solution by the Network Thermal Analyzer (NETHAN) program simulating the experimental conditions. This means that the computer model can be used for design of other sizes of coolers not studied here. Computer solutions of temperature were carried out for a wide range of cooler sizes, including the experimental model size, an approximately one-tenth size of the experimental model, and sizes larger than the experimental model. (auth)

20918 HEAT ENGINE EFFICIENCY ENHANCEMENT THROUGH CHEMICAL RECOVERY OF WASTE HEAT. Olmsted, J. H.; Grimes, P. G. (G-O Technology Inc.; New Berlin, WL). pp 241-248 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The thermodynamic efficiency of a chemically fueled heat engine (work output divided by heat of combustion of fuel input) is traditionally compared to the efficiency of a Carnot cycle having the same temperature limits. A distinctly different viewpoint is presented based upon the Gibbs free energy equation. It shows that the theoretical efficiency of such an engine is limited by the chemical potential of the fuel, with a secondary dependency on the temperature limits. The maximum theoretical efficiency of chemically fueled heat engines is shown to be much higher than the corresponding Carnot efficiency. For example, a Carnot engine fueled by coal(carbon) with chemical recovery of waste heat has a maximum thermodynamic efficiency of up to 143% of the Carnot efficiency. An example system, based upon thermo-electric devices, is discussed. Engineering constraints upon the application of these principles are identified, along with other potential application areas. (auth)

20919 SPACE POWER SPINOFF CAN ADD 10+ POINTS OF EFFICIENCY TO FOSSIL-FUELED POWER PLANTS. Wilson, A. J. pp 260-268 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The efficiency of fossil-fueled central station steam power plants has been stalled at about 40% since 1952. The high pressure (3500 to 4000 psia) and high temperature (1050 to 1100°F) barriers which steam imposes have proved to be practically insurmountable in the quest for higher power plant efficiencies. With today's clamor for cleaner, lower pollution power plants,

the impetus to achieve higher efficiencies is increased. Several alternatives are being examined by Government agencies, utilities and component suppliers. The Alkali Metal Topping Cycle in combination with a conventional steam power plant is discussed. The Alkali Metal Topping Cycle is a space power spinoff that can add 10+ points of the efficiency to fossil-fueled power plants. It can burn coal and upgrade to cleaner fuels as required. It can be ready to produce power in full-sized central station power plants early in the 1980's. There are no engineering or material breakthroughs required to make it work. After ten years of successful development of alkali metal power plant components for the space program, an evaluation of the Alkali Metal Topping Cycle for central station steam power plants is underway. A preliminary evaluation of the system was conducted as part of a proposal effort. The results of that evaluation are presented. (auth)

20920 OPTIMIZATION OF STAGED RANKINE ENERGY CONVERSION CYCLES FOR HIGH EFFICIENCY. Simmons, L. D. (Univ. of Redlands, CA). pp 279-287 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

It is proposed that staged Rankine cycles be reconsidered as a means to achieve high thermal-to-electrical energy conversion efficiency for power plants. In order to demonstrate the possible efficiency gains, binary, ternary, and quaternary Rankine cycle configurations have been optimized for maximum efficiency under a set of realistic constraints. The low temperature cycle in all cases is a simple Rankine steam cycle, and the higher temperature stages are liquid metal Rankine cycles. Maximum efficiencies are presented for the best cycle configurations with peak temperatures from 900°F to 3000°F. Sensitivity of the results to certain critical assumptions is also included. The potential efficiency gains at current peak cycle temperatures are small, but, if high temperature expanders such as graphite helical rotor expanders or MHD vapor expanders prove to be feasible turbine replacements, staged Rankine cycles can clearly provide high efficiencies with much lower temperature requirements than magnetohydrodynamic Brayton systems. (auth)

20921 3000 HOUR ENDURANCE TEST OF A 6 kWe ORGANIC RANKINE CYCLE POWER SYSTEM. Niggemann, R. E. (Sundstrand Aviation, Rockford, IL). pp 288-295 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The development and endurance testing of an organic Rankine cycle turbo-electric power conversion system is described. The 6 kW(e) organic Rankine cycle system was operated with both a surface condenser and a jet condenser at 650°F turbine inlet temperature. Performance measurements indicate that with reworked regenerators, and in the case of the jet condenser, with a pump designed for the specific operating conditions, both systems would produce a system efficiency of over 17%. The 700°F turbine inlet-jet condenser version was operated for over 3000 hours endurance. All rotating equipment was in excellent condition upon completion of the test. The bearings actually operated 3170 hours with a total of 152 start/stop cycles without damage or significant wear. (auth)

20922 LOW PEAK TEMPERATURES AND HYDRODYNAMIC BEARINGS: KEY TO LONG LIFE ORGANIC RANKINE CYCLE SYSTEMS. Boretz, J. E. (TRW Inc., Redmond Beach, CA). pp 296-302 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

In the past, the two major life limiting factors of regenerative, organic Rankine systems have been pyrolytic decomposition of the organic working fluid and bearing fatigue or wear. Practical solutions to both these problem areas can be identified at this time. The feasibility of reducing the peak cycle temperature to a low enough value so that pyrolytic decomposition becomes a negligible degradation factor is discussed. This can be accomplished by the selection of a specific organic working fluid, (i.e., CP-34) at a low enough peak cycle temperature (i.e., 425°F) to minimize this effect. With the use of regeneration, despite the resulting lower Carnot efficiency, a reasonably high Rankine cycle efficiency can be achieved. The selection of the working fluid, in general, must be matched to the overall system power level and unique requirements of the application. The solution to the bearing fatigue or wear problem is also discussed. In this case the unique thermodynamic properties of most organic working fluids (positive sloping saturated vapor curve) permits operation of the radial thrust bearings with a single phase vapor. Both hydrostatic and hydrodynamic type vapor bearings are feasible, again depending upon power level and the specific requirements of the application. These design considerations are outlined in this paper and criteria for selection of the bearing operating modes are reviewed. A further advantage of operating at low peak cycle temperatures is that the creep rate for the commonly used turbine disc materials is considerably reduced. This also enhances achievement of the long life requirements of future electric power systems. In addition, it is feasible under these conditions to use less expensive alloys, thus permitting considerable cost reduction for both materials and manufacturing. Finally, the thermal losses and/or insulation requirements in low peak cycle temperature organic Rankine cycle systems are reduced, further offsetting the impact of the lower Carnot efficiencies. In addition, lower insulation costs and increased safety of operation should result. Because of the foregoing factors, it is suggested that the organic Rankine cycle system be re-examined as a potential candidate for many of the previously mentioned applications. (auth)

20923 SPECIFICATION OF AN OPTIMUM WORKING FLUID FOR A SMALL RANKINE CYCLE TURBOELECTRIC POWER SYSTEM. Wigmore, D. B. (Sundstrand Aviation, Rockford, IL); Niggemann, R. E.; O'Sullivan, J. B. pp 303-314 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Considerable emphasis has been placed on the development of silent portable electrical power systems for field use. A closed Rankine cycle system is thought to be capable of meeting the rather stringent weight and volume goals for such a system in the .5 kW(e) to 5 kW(e) power range, and is capable of operating efficiently while being produced at a low selling cost. For a given power level the size and performance of any thermodynamic power system is sensitive not only to the type of components used and the cycle points selected, but especially to the properties of the working fluid. Results are presented of a study in which a computerized mathematical model of a Rankine cycle turboelectric system which included component design, working fluid thermodynamic and thermophysical property estimation and system performance analysis, was used in conjunction with a multivariable optimization treatment to optimize system initial cost, weight, volume and performance (over a .5 to 5 kW(e) power range) with respect to the working fluid, cycle and component design variables. The optimization resulted in a system that utilized a supercritical vaporizer, an economizer and regenerator and was capable of SFC varying from .83 lb/kW(e)-h at 5 kW(e) to 1.48 lb/kW(e)-h at .5 kW(e). The working fluid variables which resulted in the optimum system were, a molecular weight of 86, a normal boiling point of 282°F and a critical point of 653°F, 503 psia and .05 ft^3/lb. The sensitivity of system design to changes in the working fluid variables and the qualitative requirements of an ideal fluid for a Rankine cycle power plant are also developed. Since a substance having the optimum quantitative specification may not lend itself qualitatively to power system application or may not be capable of synthesis, the sensitivity of system design to changes in the working fluid variables was investigated. To supplement this information a study to determine the relationship of the qualitative requirements of a fluid to molecular structure was undertaken. A mathematical model for the system and fluid and their integration into an overall optimization program is described. The optimized system design is presented along with the results of the sensitivity study and molecular structure investigation where the candidacy of various promising chemical groups is discussed. (auth)

20924 ORMAT RANKINE POWER UNIT. Bronicki, L. Y. (Ormat Turbines Ltd. Yavne, Israel). pp 327-334 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The current interest and research in the development and application of sophisticated energy converters has directed attention to practical units with field proven reliability. Life test results of operating units are described rather than the theoretical aspects which are described in detail in the referenced material. Details of three specific applications are presented as well as general information on units which exceed one million operating hours. (auth)

20925 SUMMARY OF GAS BEARING APPLICATIONS IN THE FIELD OF SPACE ELECTRIC POWER SYSTEMS. Dunn, J. H.; Ream, L. W. (Lewis Research Center, Cleveland). pp 335-340 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The technology of closed Brayton cycle electric power systems for space was investigated. The turbine-alternator-compressor power conversion unit for such a system is designated Brayton Rotating Unit (BRU). In parallel to power system testing, a BRU improvement effort was initiated. The objectives of this effort are to improve the BRU reliability, potential life and ability to accept shock and vibration. A major portion of this effort involves the testing and evaluation of different bearing systems. A description of each bearing is presented along with results of the evaluation to date and a comparison of the merits and limitations of each bearing. (auth)

20926 ROTOR WINDAGE LOSSES FOR LUNDELL ALTERNATORS. Gorland, S. H.; Kempke, E. E. Jr. (Lewis Research Center, Cleveland). pp 341-345 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The Lundell alternator is being investigated for power system applications. At the high speeds required, power loss due to windage can become high and result in significant heating of the alternator. This loss must be incorporated in the cooling design. The velocity profiles expected in these alternators are highly turbulent, and the Reynolds numbers are well above the levels previously reported; the available data could only be extrapolated. For this reason, a range of experimental data was generated to permit accurate calculation of the windage power loss for Lundell alternator design. Windage tests were conducted on two concentric rotor-stator configurations in ambient air, producing Reynolds numbers as high as 100,000. Cylindrical rotors 10 and 12 in. in dia were operated up to 24,000 rpm, and an 8 in. dia Lundell rotor was operated up to 36,000 rpm. Gap-to-radius ratios of 0.01, 0.02 and 0.04 were tested. Tests were also conducted with axial slots machined on the stator surfaces to simulate alternator winding slots. Using the data obtained, a method was developed to calculate the windage loss for any Lundell alternator given the geometry and cavity conditions. (auth)

20927 PARALLEL OPERATION OF TWO BRAYTON-CYCLE ALTERNATORS WITH PARASITIC SPEED CONTROLLERS. Perz, D. A. (Lewis Research Center, Cleveland). pp 346-352 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The experimental paralleling characteristics of two 1200-Hz Brayton-cycle alternators are presented. Since the Brayton power conversion system uses electric speed controllers, the paralleling requirements are somewhat different from those for conventional ground-based power systems. Results include the transient effects of synchronizing the two alternators with various phase-angle, voltage, and frequency differences. Based on these results, the effects of synchronizing differences can be defined, and adjustment requirements of the parasitic speed controllers during synchronizing can be established. Data indicate that parasitically loaded alternators are able to parallel over a wide range of synchronizing differences. However, equilibrium could not be reached in extreme cases where alternator load differences were great and, at the same time, the phase-angle error was large (150° or more). (auth)

20928 APPROACH TO PERFORMANCE ASSESSMENT AND MANAGEMENT OF A LARGE SOLAR ARRAY/BATTERY POWER SYSTEM. Imamur, M. S. (Martin Marietta Corp., Denver); Nassen, H. S.; Stroud, J. D. pp 373-383 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A large amount of design verification testing has demonstrated the basic compatibility of the individual subsystems in the 8 kW solar array/battery power system for the manned Skylab Program. However, overall system capability is determined by analytical methods. A mathematical model used to determine the power capability and margin is based on a conventional energy-balance relationship and operating restrictions imposed on the batteries. A simplified energy-balance equation is shown to be adequate and highly useful for the spacecraft operating mode in which the solar arrays are oriented to the sun, while a more detailed model was found to be necessary for the nonoriented mode. Limitations of these mathematical models, the methods being used to accurately determine the electrical loads, basic power capability, and power margin are discussed. Finally, based on present Skylab activities and experience, several considerations are presented for the management and analysis of solar array/battery power systems for future space vehicles. The considerations are applicable to any power system of this type, but some of them are specifically directed to large power systems. (auth)

20929 PROGRESS REPORT: SPACE STATION SOLAR ARRAY PROGRAM. Chidester, L. G. (Lockheed Missiles and Space Co. Inc., Sunnyvale, CA). pp 409-419 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The technology programs that should be initiated to insure "technology readiness" of solar photovoltaic power systems in the 25 to 100 kW range for application to Manned Orbital Space Stations are discussed. Large flexible solar arrays are identified as an important pacing technology for Space Station development. As a result, in mid 1970 the Space Station Solar Array Technology Evaluation Program (SSSA TEP) was initiated. The principal goal of the SSSATEP program was to determine the feasibility of designing and building extremely large area solar arrays. Therefore, a great emphasis was placed on reaching the point where a representative amount of full scale hardware could be fabricated and evaluated. The results and conclusions of the three major program phases are discussed. The Technology Evaluation Phase includes a complete review of all analysis, studies, and test results related to lightweight solar array technology up through and including 1970. Conclusions drawn from this review are presented and recommendations made as to where additional research and development work was required to support development of the 10,000 ft^2 Space Station Array having a design lifetime of 10 y. The Design and Analysis Phase used the work accomplished to date on other R&D studies, and the groundwork performed by the Space Station Prime Contractor as a base to complete a detail design of a 10,000 ft^2 100 kW, continuous sun tracking system. The analysis used to arrive at this design was based on a rigorous set of design requirements. In the Development Test Program Phase using the above design, full scale hardware representing one quadrant (2,500 ft^2) of the 100 kW array design was fabricated and subjected to a test evaluation program. Results and conclusions of the test program are presented. Summaries of these major phases with selected significant results are provided along with photographs of hardware designed, fabricated, and tested throughout the program. (auth)

20930 ELECTRICAL POWER SUBSYSTEM DEFINITION FOR SHUTTLE LAUNCHED MODULAR SPACE STATION. Nussberger, A. A. (North American Rockwell Corp., Seal Beach, CA). pp 420-429 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The electrical power subsystem resulting from the Modular Space Station Program, Phase B Extension period study is described. The subsystem provides primary electrical services utilizing a 2 degree of freedom solar array. Power during the sun eclipse period is provided by fuel cells operating from stored reactant supply generated by water electrolysis during sunlight periods. Each assembly description includes sizing requirements, performance capability (both nominal and secondary), and final physical installation data. The different mission operational modes are covered which include initial modular space station (MSS) buildup, emergency and degraded operations, and long duration normal station operations. (auth)

20931 CONFIGURATION SURVEY OF LIGHTWEIGHT SOLAR ARRAY POWER SYSTEMS FOR FUTURE MISSIONS. Lott, D. R. (Lockheed Missiles and Space Co., Inc., CA). pp 430-437 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A variety of future NASA missions using solar photovoltaic power for the primary electrical power source, are identified and categorized. Projected solar array configurations that are based on the technology evolved in the Space Station Solar Array program are presented for the selected missions. The missions reviewed represent a wide diversity of power levels, array sizes, packaging and deployment constraints and provide the require-

ments base for assessing modularity. Depending upon the on orbit dynamic loads imposed, which vary from zero to over 1 G., system weights are presented and the power density range (W/lb) is identified. (auth)

20932 SOLAR ARRAY AND BATTERY ELECTRICAL POWER SUBSYSTEM FOR THE SHUTTLE-LAUNCHED MODULAR SPACE STATION. Murray, W. E. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). pp 438-450 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A summary is presented of the solar array/battery electrical power subsystem designed for a space shuttle-launched modular space station. It identifies the driving design requirements, discusses the major trade studies which were conducted, and provides the criteria which were used for selection. A design summary is provided to describe the major assemblies and their unique system characteristics. The study included considerations of the cost and weight impacts of system voltage levels, primary voltage regulation methods, and controlled energy storage on this weight-limited design. Some of the significant conclusions are as follows: a flexible solar array is necessary in preference to a rigid array to satisfy weight and volume constraints; a solar array modularity based upon two equal units is the most cost-effective choice; nickel-cadmium batteries are more cost effective than alternatives based on regenerative fuel cells for the mission conditions and the selected Space Station configuration; a moderate voltage increase to 120 Vdc promises very considerable benefits in weight and cost, due to higher electrical efficiency; and the sequential partial shunt regulation method for solar array voltage regulation offers power and weight savings within the predicted array temperature range of operation. The high degree of dependence of an electrical power subsystem design upon the mission and configuration requirements and the program constraints produces a design which is unique within this framework. (auth)

20933 SYSTEM DESIGN CONSIDERATIONS FOR A 25kW SPACE STATION POWER SYSTEM. Turner, G. F.; Johnson, A. K.; Gandel, M. G. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). pp 451-456 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Over the past two years two parallel space station design studies were conducted to define the ranges of requirements for the space station solar photovoltaic power system. In addition to these overall systems design efforts, detailed design information has been generated in the two critical component areas of sun tracking solar array systems and 100 Ah nickel-cadmium battery modules. These system definition studies and component development efforts formed the basis for a set of power system tradeoff studies to identify payoffs and penalties associated with several integrated solar array/energy storage/power control and distribution design approaches. Solar array designs were generated for the space station concepts and power requirements. A system weight model was generated based on these solar array and tracking system designs, including estimates of all power generation, storage and control components exclusive of power transmission. Using this model, alternate system design approaches were considered and evaluated including the use of regenerative fuel cells for energy storage. A suggested power system design approach is presented employing a regenerative fuel cell concept closely integrated with the environmental control and life support system and with the solar array power source. The electrolysis section of the system is employed for fuel generation, generation of fuel cell and life support oxygen and generation of hydrogen for the Sabatier reactor. Electrically the electrolysis units are employed in conjunction with a shunt regulator system to provide a combined energy storage/peak power regulation function. Results of this study indicate that photovoltaic power systems having weights and performance consistent with shuttle-launched space station requirements can be developed even when worst-case space station requirements such as artificial "g" power generation and maximum anticipated loads of 25kW for 10 y are applied. Significant weight savings can be obtained through development of regenerative fuel cells, particularly if these systems are employed to provide auxiliary functions such as peak power leveling and generation of ECS/LSS gases. (auth)

20934 DYNAMIC SOLAR-ELECTRIC POWER/THERMAL CONTROL SYSTEM FOR SPACECRAFT. Davis, B. K. (Marshall Space Flight Center, Huntsville, AL). pp 457-465 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From seventh intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A solar-electric power and active thermal control system for spacecraft with a solar energy to electricity conversion efficiency of more than 20% is described. Briefly, the solar heat-energy is absorbed by flat plate collectors yielding above 70% of the energy incident for conversion by an organic condensing cycle. The cycle operates between 132°C and 6.67°C. The working fluid is F-114 which flows through a solar collector to absorb heat, then through a regenerator and into the radiator where it is condensed to a liquid. The cold liquid flows through two paths, one providing regenerator cooling, the other providing spacecraft thermal control. The liquid paths join and collect I^2R losses from the alternator in returning to the solar collector. The system total weight is about 170 kg/kW of electrical energy produced. A similarly sized solar cell system weighs 306 kg/kW, still does not provide active thermal control. The solar cell "sail" area is about twice the sail area of this system with attendent high moments of inertia and control problems. The solar cell output degrades at about 6%/y due to surface deterioration, whereas no such problem exists in the dynamic system. The dynamic system replaces batteries by a thermal capacitor for eclipse period energy storage, thereby eliminating many battery charging and control problems as well as improving efficiency and weight characteristics of the system. The thermal capacitor is inherently a long-life system with a reliability expected to be much greater than batteries. The dynamic system proposed essentially resulted from a systems evaluation of the possible interaction between the power generation and overall thermal control subsystems for a long-term manned spacecraft and suggested a beneficial combination of functions and hardware of the two systems. (auth)

20935 FLEXIBLE SOLAR ARRAY: A SPACECRAFT ELECTRICAL POWER SOURCE TECHNOLOGY OPTION. Massie, L. D. (Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH). pp 501-506 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A 1.5 kW flexible solar array is described. The space power advanced development program included the design, fabrication, qualification for flight, and orbital flight test of the 1.5 kW size array. The flexible solar array flight experiment was launched by a thrust augmented Thor/Agena vehicle system into a 400 NM polar orbit on 17 October 1971 and has successfully completed a six months' flight test. The array occupies very low volume and has very low weight-6 ft^3/kW and 100 lb/kW at the 1.5 kW power level. These performance figures include the volume and weight of a 2-axis orientation mechanism which provides for slipring/brush assembly electrical power transfer across the rotating interfaces and automatic sun acquisition and tracking to ensure maximum delivery of energy to the spacecraft. At the 3 kW power level, to which the basic concept can be readily adapted by adding another flexible array to the other arm of the orientation mechanism, the performance capability is 4.8 ft^3/kW and 81 lb/kW. With minor modifications, the basic 1.5 kW flexible array concept is adaptable to power levels ranging from 5 kW to 20 kW. The required modifications primarily involve varying the extension length of the deployment BI-STEMS (storable tubular extendible members) and the drum length as well as structurally upgrading the orientation mechanism and increasing the number of power sliprings. Array configurations for the 1.5 kW, 5 kW, 10 kW, and 20 kW sizes are shown schematically and compared in terms of weight and area. A flexible solar array versus a rigid solar array 5.2 kW low earth orbit power subsystem comparison reveals that a weight savings of approximately 900 lb is realized by use of the flexible array concept. (auth)

20936 SATELLITE SOLAR POWER STATION: AN OPTION FOR POWER GENERATION. Glaser, P. E. (Arthur D. Little Inc., Cambridge, MA). pp 507-511 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Satellite Solar Power Stations (SSPS) are space satellite-located solar cells which convert solar energy to electric power which is in turn transmitted to earth by microwave beams. The development status of the three components of this power system, i.e., the satellites, solar cells, and microwave transmitting equipment is reviewed. Plans for developing an operational SSPS system in the 1990's are discussed. (LCL)

20937 SOLAR COLLECTOR THERMAL POWER SYSTEM: ITS POTENTIAL AND DEVELOPMENT STATUS. Mahefkey, E. T. Jr. (Air Force Systems Command, Wright-Patterson AFB, OH). pp 512-521 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The evolution of the Vuilleumier cryogenic cooler as the foremost cryogenic refrigerator candidate for several military and scientific spacecraft applications has prompted interest in a Solar Collector Thermal Power System (SCTPS) to provide the necessary thermal energy input (nominally 2 to 3 kW(t) at 1100 to 1250°F). Study efforts to define the performance potential of the (SCTPS) are described. The results of these studies and corroborative experimental results on system component performance characteristics are described. The SCTPS is comprised of a solar collector, or concentrator, orientation system, and heat receiver. Thermal energy storage is accomplished by melting an inorganic salt. Energy transport and management are accomplished by heat pipes. To provide auxiliary electrical power to the Vuilleumier cooler and the spacecraft a small solar cell array is employed. Thermal energy is delivered to the Vuilleumier cooler via a radiative heat transfer coupling. The performance (efficiency weight, volume, deployed area), costs, and integration ease of the SCTPS are compared to that of a conventional solar cell array/battery and a modified SNAP-10A nuclear reactor system. These comparisons show the SCTPS offers greater than a 50% weight reduction over the competitors, and the deployed area of the SCTPS is only 20% that of a solar array/battery system. Efficiency of the SCTPS is predicted to be 50% for the solar to thermal conversion and heat transport/thermal energy storage processes. Development problems for the SCTPS are described which include verification of heat pipe performance, evaluation of the heat pipe-thermal energy storage thermophysical behavior, heat receiver thermophysical and thermomechanical integrity, and demonstration of thermal control and thermal management techniques to provide the required thermal energy with the temperature limits (nominally ±20°F) acceptable to the cooler. Experimental results on the performance of a subscale integral sodium heat pipe/LiF thermal energy storage unit are described. Operation of the device is shown to be nearly isothermal (±15°F) during the thermal charge/discharge cycle in a simulated 60/30-minute orbit. Heat pipe design for a full scale (15 foot, 3 kW) heat pipe are reviewed. (auth)

20938 ISOTOPE BRAYTON ELECTRIC POWER SYSTEM FOR THE 500 TO 2500 WATT RANGE. Macosko, R. P.; Barna, G. J.; Block, H. B.; Ingle, B. D. (Lewis Research Center, Cleveland). pp 522-527 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

An extensive study was conducted to evaluate an isotope Brayton electric power system for use in the 500 to 2500 W power range. The study emphasized overall system simplicity in order to reduce parasitic power losses and improve system reliability. The study included detailed parametric cycle analysis, conceptual component designs, and evaluation of system packaging. The study has resulted in the selection of a single-loop system (gas) with six major components including one rotating unit. Calculated net system efficiency varies from 23 to 28% over the power range. The use of the ^{238}Pu heat source being developed for the Multi-Hundred-Watt Radioisotope Thermoelectric Generator program was assumed. This heat source is currently under development by the Atomic Energy Commission and is scheduled to fly on a Department of Defense mission in 1974. (auth)

20939 CONCEPTS FOR APPLICATION OF 500- TO 2500-We BRAYTON POWER SYSTEMS FOR SHUTTLE-LAUNCHED MISSION. Block, H. B.; Bloomfield, H. S. (Lewis Research Center, Cleveland). pp 528-533 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A Mini-Brayton Study, in the power range of 500 to 2500 W(e), utilizing the Multi-Hundred Watt (MHW) isotope heat source was conducted at the Lewis Research Center. Existing Brayton technology was applied along with major design goals of system simplicity, high efficiency, and low parasitic losses. Mini-Brayton power system conceptual configurations are presented which are integrated with typical shuttle-launched experiments and designed with nuclear safety considerations and shuttle integration in mind. Also presented are a number of Mini-Brayton mission advantages and general operation descriptions for various mission phases. (auth)

20940 ISOTOPE POWER SYSTEMS FOR UNMANNED SPACECRAFT APPLICATIONS. Jaffe, H.; O'Riordan, P. (Atomic Energy Commission, Washington, DC). pp 534-539 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Radioisotope thermoelectric generators have been in use for space applications since 1961. The first such system, a 2.7 W device, is still producing power. Substantial operational experience has been accumulated in the past three years on SNAP-19 type systems from the Nimbus III weather satellite and the Pioneer 10 Jupiter probe, and on SNAP-27 in the ALSEP stations left on the lunar surface. Operating experience from these three missions is presented. Other applications for which RTG's are now being designed, including NASA's Viking Mars lander and Mariner Jupiter Saturn outer planet spacecraft, and DOD's TRANSIT navigational satellite and LES 8/9 communication satellite, are described. (auth)

20941 NAVY TRANSIT RTG SAFETY AND TEST INTEGRATION FROM USERS VIEWPOINT. Weiner, R. I. (Weiner Associates, Inc., Cockeysville, MD); Pyatt, D. W.; Starr, M. D. pp 540-546 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The assurance of obtaining launch approval for a ^{238}Pu fueled Radioisotope Thermoelectric Generator (RTG) for the Navy Transit Satellite, producing 30 W(e), requires a high confidence level that the ^{238}Pu be contained for all normal reentry environments and for all accident environments during prelaunch, launch pad, early launch abort, and preorbital insertion abort. In order to verify this, an extensive testing and analysis program was established by the US AEC. An independent evaluation of the safety and integration program from a user standpoint was conducted. This work consisted of independently verifying the AEC's safety analyses, reviewing test programs and test results. The interaction of the actual safety analyses were assessed. Subsequently, the tests on the RTG components design and total systems performance were evaluated. These assessments were made to evaluate the degree to which the RTG met the Interagency requirements and specifications for safety acceptance and launch approval for the user. This was the first time an organization representing the Navy followed and critiqued an RTG program from inception through launch approval. The value of a user independent safety review role in the development and flight chain of RTG Systems is shown. (auth)

20942 MODELING AND DESIGN OPTIMIZATION OF A SPACE-ORIENTED THERMOELECTRIC POWER SUPPLY. Schorr, A. W. (Westinghouse Electric Corp., Pittsburgh); McManus, H. N. Jr. pp 547-555 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The numerical modeling and design optimization of a thermoelectric power supply is discussed. The design study uses a method of constrained steepest descent permitting the simultaneous variation of the independent parameters which are restricted to remain within specified boundary constraints. The equations describing the thermal-electric model of the fuel capsule and generator are developed and the system is then designed so as to maximize the efficiency and/or specific power. The optimization yielded generators with maximum efficiencies of 9.5% and with maximum specific powers of 4.06 W/lb for the various constraints considered. A sensitivity analysis giving the increase in generator performance by relaxing selected constraints is discussed. (auth)

20943 NUCLEAR POWER SYSTEM STUDY. Van Osdol, J. H. (Atomics International, Canoga Park, CA); Hengle, J. E.; Reardon, D. E.; Wilson, R. F. pp 559-567 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A study was performed to determine the preferred nuclear power source for spacecraft using either of four types of cryogenic cooler cycles, i.e., the rotary reciprocator, Vuilleumier, turbobrayton, or Stirling. These spacecraft require electrical power in the 1 to 4 kW range, long satellite life (3 to 5 years), and relatively low earth orbits. The nuclear power systems investigated included both radioisotope and reactor heat sources. For the radioisotope systems, RTG's and heat sources with Brayton or organic-Rankine

power conversion systems were considered, with either Pu or Cm as the fuel. Reactor systems were limited to the zirconium-hydride reactor, with either thermoelectric, Brayton, or organic-Rankine power conversion systems. For the Vuilleumier cooler, where both electrical and thermal power were required, a radioisotope heat-source was considered in conjunction with a solar array. Spacecraft designs and integration concepts were developed for each type of power system over the range of mission and system parameters specified. For the reactor systems, available technology, simplicity, reliability, and cost considerations dictated the choice of thermoelectric power conversion. In the power ranges of interest, it was determined that systems utilizing radioisotope/dynamic power conversion systems were somewhat lower in weight than and comparable in area and integration flexibility to reactor systems. The large number of systems required resulted in all of the radioisotope systems being substantially more expensive (including prorated R&D costs) than reactor systems; however, RTG's limited to the Multi-Hundred Watt and SNAP 19 Systems were not competitive in the power range of interest. For these reasons, the reactor-thermoelectric system was selected as the preferred nuclear power system for the spacecraft concepts studied. (auth)

20944 PIONEER RTG PROGRESS. Russo, F. A. (Teledyne Isotopes, Timonium, MD). pp 568-571 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The status of the SNAP 19/Pioneer RTG program through June 1972 is discussed. Emphasis is given to performance of the generators delivered for the first mission to Jupiter and comparison between predicted and observed power output. Additional information is included to describe the qualification test activities and significant design modifications incorporated to increase confidence in the ability of the RTG to satisfy the Pioneer program objectives. Flight performance of the RTG power system is shown to be nominal, thereby indicating successful accomplishment of design goals. (auth)

20945 COMPUTER SIMULATION CONCEPT FOR A LARGE SOLAR ARRAY/BATTERY POWER SYSTEM. Imamura, M. S.; Conn, A. A.; Peszko, A. J.; Scott, R. C. (Martin Marietta Corp., Denver). pp 607-619 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Development of a computer simulation model for analyzing the performance of an electrical power system must include careful consideration of a number of factors such as accuracy, speed, flexibility, and cost. The concept presented represents an achievable compromise among these factors in providing an integrated simulation model for a large solar array/battery power system. Because of the complex external interfaces with the power system and the need to achieve a reasonable level of accuracy and flexibility in the analysis, many of the key external variables were integrated in the model. That is, models to calculate variables such as spacecraft attitude, solar array shadow and temperature were incorporated in lieu of a simple data-retrieval technique. The assumptions, trade-offs and logic for each simulation subsystem are discussed. Also, in some cases, the rationale for a specific approach used is included. (auth)

20946 AUTONOMOUS POWER SUBSYSTEM DESIGN FOR AN OUTER PLANET SPACECRAFT. Andrews, R. E. (General Electric Co., Philadelphia); Wick, H. M. pp 630-638 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The scientific investigation of the outer planets requires a solar-independent, highly reliable spacecraft capable of autonomous operation for periods up to twelve years. From July 1968 to November 1971 the Jet Propulsion Laboratory was engaged in an Advanced Systems Technology project to develop an understanding of spacecraft requirements and to initiate developments in the critical technology areas that would be required to successfully carry out a mission to the outer planets. The overall design of the Thermoelectric Outer Planet Spacecraft (TOPS) power subsystem is described. It discusses the implementation of spacecraft requirements into a fault-tolerant design in which an onboard self-test and repair computer is utilized to provide autonomous operation. Development of a "protected bus" concept is discussed whereby electrical power supplied to essential spacecraft loads is maintained in the event of major on-board "power blackouts." Particular attention is given to describing the interfaces and operation of the power subsystem with the spacecraft control computer subsystem. Autonomous power management operations are discussed where the on-board computer adjusts the spacecraft load demand to provide maximum utilization of source power for a given mission mode. (auth)

20947 RESULTS OF SOLAR CELL WELDED INTERCONNECTION DEVELOPMENT. Eakins, T. C. (Hughes Aircraft Co., El Segundo, CA). pp 651-660 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Potential benefits that can be realized by welded solar cell interconnection in contrast to conventional soldering are presented. Development efforts over the past 5 y with various types of welding approaches are reported with emphasis on ultrasonic techniques. (LCL)

20948 STATISTICAL ANALYSIS APPLIED TO SOLAR CELL FATIGUE FAILURE. Garner, N. R.; Rauschenbach, H. S. (TRW Systems Group, Redondo Beach, CA). pp 661-664 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The use of LMTAB, a new statistical technique, is demonstrated for determining probability of failure curves as functions of stress and time. These curves can be extrapolated when only limited experimental data are available. The technique is illustrated by application to results of solar cell modules subjected to thermal cycling. It is shown that this technique can provide probability of joint cracking and open interconnect curves as a function of thermal cycling based on few test points; these curves can be used to extrapolate beyond the test time. In addition, the limits of the error of estimate are known. (auth)

20949 PREDICTION OF FATIGUE FAILURES IN SOLAR ARRAYS. Rauschenbach, H. S.; Gaylard, P. S. (TRW Systems Group, Redondo Beach, CA). pp 665-675 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Analytical methods were developed to aid in the design optimization and prediction of the fatigue life of solar cell interconnector systems under temperature cycle loading. Stress distributions in interconnector loops and in soldered and welded joints were calculated for elastic and elastic-plastic material properties, using finite element methods. Manson's universal slope method for predicting fatigue life has been extended to include changes in material properties with temperature. Correlation of analytical results with test data shows reasonably good agreement. Limitations of the methods are indicated. (auth)

20950 DETERMINATION AND TREATMENT OF TEMPERATURE COEFFICIENTS OF SILICON SOLAR CELLS FOR INTERPLANETARY SPACECRAFT APPLICATION. Patterson, R. E.; Yasui, R. K.; Anspaugh, B. (California Inst. of Tech., Pasadena). pp 676-681 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The electrical performance characteristics of 2 Ω-cm and 10 Ω-cm N/P-type silicon solar cells were measured at simulated solar intensities of 5, 25, 50, 100, 140, 250, 400, 550, 700, and 850 mW/cm^2. At each intensity the temperature was varied in increments of 20°C between temperature extremes of +160 and −160°C. Short-circuit current, open-circuit voltage, and maximum power are presented in graphical format. Also presented are three methods for predicting solar cell electrical performance as a function of temperature and intensity. Two of the methods are suitable for use at extreme temperature-intensity conditions. These methods were used to successfully predict the performance of the $I_{sc} - V_{oc}$ transducer on board the Mariner Mars 1971 spacecraft. (auth)

20951 LARGE AREA WRAPAROUND CONTACT SILICON SOLAR CELL: APPLICATION AND DEVELOPMENT. Mann, J. A. (Lockheed Missiles and Spaces Inc., Sunnyvale, CA); Ling, K. S. pp 691-696 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Several problems associated with the use of conventional (top

side "N" contact) solar cells have led to the selection of large area wraparound contact cells for space station solar array design. First, the series tab has been identified as a prime cost factor in that it complicates assembly due to its stress relief forming and soldering, packaging and cleaning. Further, temperature cycling tests have identified it as a potential failure mechanism. The top contact also prevents total cell coverage by the filter which complicates filtering and increases its vulnerability to radiation degradation. The wraparound cell offers a plausible solution to these problems at a substantial cost savings in material and assembly dollars. Attention was devoted to two specific areas: evaluation of conventional and wraparound contact cells relative to cost, size, soldered vs solderless and performance as would pertain to lightweight flexible solar arrays and compatibility with low cost assembly (suitability for automated mass production techniques); and to develop, establish feasibility and deliver a quantity of the cells for assembly and test evaluation. (auth)

20952 DESIGN AND DEVELOPMENT OF A LIGHTWEIGHT FLEXIBLE SOLAR ARRAY COMPATIBLE WITH MASS PRODUCTION TECHNIQUES. Mann, J. A.; Palmer, W. L. (Lockheed Missiles and Space Co., Sunnyvale, CA). pp 697-703 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A lightweight flexible solar array is under design and development to supply primary power for an earth orbiting space station. Because of this large (10,000 ft^2) array size, emphasis had to be placed on lightweight construction and reduction of array production costs. The design and materials selection for the basic electrical module are described and facilitation of future mass production and automation as a key to lower costs is discussed. Space station power and packaging requirements made it necessary to use 12 ft^2 size modules. Processing techniques had to be developed for making and handling these 2 ft × 6 ft modules using available facilities. Smaller modules could be made using the same basic design concepts and fabrication techniques by simply scaling the module sizes and interconnection patterns to meet particular power levels and quantity requirements. The flexible panel design is somewhat different than conventional solar panel systems in that it is flexible, employs adhesiveless printed circuit assembly and uses wrap-around contact solar cells. These features were found to reduce and simplify assembly steps and minimize complexity of rework and repair. (auth)

20953 SYSTEMS ENGINEERING OVERVIEW OF THE SATELLITE POWER STATION. Mockoviak, J. Jr. (Grumman Aerospace Corp., Bethpage, NY). pp 712-719 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The utilization of solar energy as a prime power source has been a long-held dream of mankind. With increasing attention focusing on the energy crisis, many new schemes are being proposed involving both space-based and ground-based applications of solar energy. Among these is a proposed concept of a Satellite Solar Power Station (SSPS), which collects energy from the sun and transmits it to earth via microwave for conversion to electrical power. Recent systems engineering studies, assessing the technical and economic aspects of the SSPS are presented. These studies indicate that the basic concept is technically feasible, and that it should be examined and compared to other potential energy systems. (auth)

20954 COMPARISON OF POWER SOURCES FOR ADVANCED PACEMAKER APPLICATIONS. Rasor, N. S.; Spickler, J. W.; Clabaugh, T. L. pp 752-760 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Factors contributing to the relatively large power delivered to the stimulating electrodes in conventional pacemaker practice are reviewed. Demonstrated techniques for substantially suppressing these factors are described. Prospects for lowering power requirements by at least an order of magnitude appear to be excellent. The relative attractiveness of various nuclear, chemical and biological power sources is considered in light of this probable reduction in power requirement. It appears that solid state chemical batteries presently being marketed will be suitable for powering subcutaneous pacemakers longer than ten years. It is concluded that nuclear batteries, with the possible exception of the tritium-powered battery, probably will not compete successfully with chemical batteries in the next generation of conventional subcutaneous pacemakers. It is felt, however, that nuclear batteries can be important to the feasibility of more demanding advanced pacemaker applications such as the intracardiac pacemaker. (auth)

20955 DESIGN CRITERIA AND TWO-YEAR CLINICAL RESULTS OF ^{238}Pu-FUELED DEMAND PACEMAKER. Hixson, J. D. (Medtronic Inc., Minneapolis); Laurens, P. pp 765-770 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The design, operation, and specifications of implantable cardiac pacemakers powered by ^{238}Pu-fueled thermoelectric generators are described and the clinical studies of 26 European patients who have had such pacemakers implanted since 1970 are discussed. (LCL)

20956 PERFORMANCE OF A NUCLEAR-FUELED CIRCULATORY ASSIST SYSTEM UTILIZING A TIDAL REGENERATOR ENGINE. Huffman, F. N. (Thermo Electron Research and Development Center, Waltham, MA); Hagen, K. G.; Ruggles, A. E.; Harmison, L. T. pp 771-777 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A nuclear-powered artificial heart system has reached the stage of in vivo testing. It is powered by an electronically-controlled tidal regenerator engine (TRE) having neither valves nor sliding seals. This engine is a pressure-balanced vapor cycle analog of the regenerative gas cycle. It is hydraulically coupled to a left ventricular assist pump of advanced design which also functions as a blood-cooled heat exchanger and pressure-volume transformer. A Hall sensor provides control information; electric power to operate the control subsystem is supplied by a thermoelectric module interposed between the superheater and boiler. Engine efficiencies of over 7% have been achieved at 90 beats per minute, with corresponding pump efficiencies of 75%. Nuclear-powered implants have confirmed the ability of the system to be synchronously counterpulsed with the natural heart. (auth)

20957 FEASIBILITY OF UTILIZING MHD FOR POWERING HIGH-SPEED LAND VEHICLES. Lacey, J. J.; Spencer, F. E.; Demeter, J. J.; Bienstock, D. (Bureau of Mines, Pittsburgh). pp 1022-1027 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The Office of High Speed Ground Transportation (HSGT), U. S. Department of Transportation (DOT) evaluates many possibilities for providing "on-board" power for high speed land vehicles. These power systems must be compact and offer high thermal efficiencies with minimum atmospheric pollution. At the request of HSGT, a feasibility study was made for a power plant featuring an open cycle MHD topping stage combined with a closed Brayton cycle bottoming plant. The MHD stage would consist of high temperature combustion with cesium seeding. The bottoming plant would use helium as the working fluid. A nominal 15,000 HP application was investigated. The original combustion system considered was hydrogen and oxygen since it offered zero pollution and minimum seed recovery problems; however, excessive flame temperatures, low MHD duct mass flow rates, and the debit associated with liquid O_2 generation eliminated this system from consideration for this particular application. Further evaluations were made utilizing preheated air as the oxidant. The various fuels investigated were hydrogen, methane jet fuel, and diesel oil. The hydrogen-air system had adequate mass flow rates, gave acceptable combustor temperatures and attained thermal efficiencies over 40%. Since hydrogen storage could possibly pose safety problems, the use of methane and jet fuel was considered. These fuels gave slightly lower thermal efficiencies than hydrogen and posed more difficult seed recovery problems. Nevertheless, it was concluded that methane and jet fuel were feasible for this particular application; however, experimental verification would be required. Diesel fuel has more pronounced seed recovery problems and was not recommended for this application. This preliminary study concentrated on process and power flow investigations for the systems under consideration. It was recommended that further experimental work be initiated in the areas of catalytic reduction of NO, cesium seed recovery, and MHD generator duct operation. (auth)

20958 PERFORMANCE OF THE BETTER METALLIC ELECTRODES IN CESIUM THERMIONIC CONVERTERS. Morris, J. F. (Lewis Research Center, Cleveland). pp 1050-1053 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Outputs are presented for some cesium diodes having primarily emitters of highly oriented polycrystalline or single-crystal 110 W or 0001 Re. Power densities at 10 A/cm^2 or 0.5 V appear as functions of emitter temperatures and electrode spacings. (auth)

20959 PERFORMANCE IMPROVEMENT OF CESIUM THERMIONIC CONVERTERS BY ADDITION OF OXYGEN. Rufeh, F. (Thermo Electron Corp., Waltham, MA). pp 1054-1059 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Addition of minute quantities of oxygen to cesium thermionic converters can improve the performance significantly. The improvement in performance provides higher power output and efficiency and allows operation at lower emitter temperatures which simplifies materials problems. The interelectrode spacing can also be increased, simplifying construction and increasing the reliability of thermionic converters. One technique for providing oxygen relies on the dissociation or evaporation of metal oxides. Such oxides were successfully formed on the collector surface of a thermionic converter and resulted in a significant increase in performance. For example, at an emitter temperature of 1800°K, an interelectrode spacing of 20 mils, and a current density of 10 A/cm^2, the output voltage increased from 0.3 V to 0.6 V. The converter completed 1500 h of stable performance. Similar experiments carried out in cylindrical converters designed for use in thermionic reactors also showed improved and stable performance. Another technique for providing oxygen is to use a solution of cesium oxide in cesium as a source of both oxygen and cesium. However, the required mole fraction of Cs_2O in cesium must be found experimentally. A thermionic converter has been constructed that allows addition of various quantities of oxygen to the cesium reservoir. Performance was tested for the $[Cs_2O/(Cs_2O + Cs)]$ mole fractions of zero, 0.006 and 0.018. No difference in performance was observed. Work is underway to increase the mole fraction ratio until the oxygen effect is observed. The advantages of this technique for providing oxygen are the ease of formation of the cesium oxygen system and the possibility that the required reservoir temperatures can be higher than the usual cesium reservoir temperatures. (auth)

20960 OUT-OF-CORE VERSION OF A SIX-CELL HEAT-PIPE HEATED THERMIONIC CONVERTER ARRAY. Kroeger, E. W.; Ward, J. J.; Breitwieser, R. (Lewis Research Center, Cleveland). pp 1066-1072 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A thermionic system concept is described which incorporates a heat-pipe cooled fast spectrum reactor and six-cell thermionic converter modules located in the space radiator. Much of the technology being developed for the in-core thermionic reactor concept is directly applicable to this out-of-core concept, particularly the fuel and converter development activity. The major technology extension required is in the area of heat-pipes for cooling the reactor and carrying thermal energy from the reactor station to the converters. The performance characteristics of an out-of-core thermionic system at power levels between 40 and 70 kW(e) are summarized, the adaptation of in-core technology to the out-of-core concept is described and applicable heat-pipe technology programs now underway are discussed. (auth)

20961 LASER ENERGY TRANSFER: AN ANALYTIC SURVEY OF HIGH POWER APPLICATIONS. Arno, R. D.; MacKay, J. S.; Nishioka, K. (Office of Aeronautics and Space Tech., Moffett Field, CA). pp 1116-1124 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Laser systems open an entirely new option for performing some functions of conventional power, propulsion, and energy transfer systems. Whether they are technically competitive or economically viable is much less certain. Some of the results of an investigation into the application of lasers to energy transfer systems are reviewed. Although laser system applications displayed some unique characteristics and capabilities, it became obvious that any large scale replacement of existing systems and methods by lasers would require many simultaneous advances in laser and associated systems states-of-the-art. It became immediately apparent that the high power and long duration operating requirements of most of the applications would require closed cycle flowing gas systems—a major advance from the present open cycle, short-burst capability. It was also apparent that current low laser efficiency would make the closed cycle systems heavy relative to other techniques of power handling. Furthermore, the theoretical advantages of focusability and high power density rest heavily on advanced methods and materials in optics and pointing systems. Three to ten m dia optics near the diffraction limit and 0.1 μrad or better pointing will be required. Laser receivers and power converters with 20 to 40% efficiency will be necessary but are considered reasonable objectives. Some of the laser system drawbacks can be countered, however, and several applications appear very interesting. For example, low orbit drag make-up, orbit changing, aircraft power, and launch vehicle power, all have promising implications; promising, that is, if the laser generator remains on the ground where its weight is not so important, or if it can be used many times in space so as to amortize its launch costs. (auth)

20962 HALL CURRENT EFFECTS IN THE LEWIS MAGNETOHYDRODYNAMIC GENERATOR. Nichols, L. D.; Sovie, R. J. (Lewis Research Center, Cleveland). pp 1125-1130 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Data obtained in the Lewis MHD generator are compared with theoretical values calculated using the Dzung theory. The generator is operated with cesium seeded argon as the working fluid. The gas temperature varies from 1800 to 2100°K, the gas pressure from 19 to 22 N/cm^2, the Mach number from 0.3 to 0.5, and the magnetic field strength from 0.2 to 1.6 T. The analysis indicates there is incomplete seed vaporization, and that Hall current shorting paths (through the working fluid to ground at both the entrance and exit of the channel) are limiting generator performance. (auth)

20963 FIELD–PARTICLE INTERACTIONS: A POSSIBLE ENERGY SOURCE. Eaton, I. R. (Purdue Univ., Lafayette, IN).. pp 1135-1140 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

At present energy needs are derived from the potential energy stored in the nuclear field of the nucleus, the electric field of the atom, or the gravitational field of the earth. This energy is, in many cases, converted to thermal agitation by various forms of utilization equipment. The energy per particle in the source is, in most instances, several orders of magnitude greater than that required for use. This suggests the desirability of searching for new sources with low energy per particle. The Maxwellian distribution of energy of the many molecules of a gas volume is well known. Maxwell proposed an imaginary scheme for grouping together those molecules of higher than average energy and so producing a region of elevated temperature. An experimental system of fixed and moveable magnets described herein strongly suggests that particles of higher than average energy may be separated from a random distribution by field-particle interactions. Perhaps we should look for a modern-day version of Maxwell's Demons. (auth)

20964 SLIP PARAMETER FOR ELECTROGASDYNAMIC GENERATORS WITH UNSTEADY FLOW. Biblarz, O. (Naval Postgraduate School, Monterey, CA). pp 1169-1171 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

In order to achieve relatively good efficiencies, the slip parameter in an electrogasdynamic generator must be low. But a low slip parameter calculated for steady flow may be unsatisfactory if there exist significant levels of turbulence in the flow. This turbulence may arise from several sources, a particular one being the mixing region of two flows. The slip parameter concept can be extended to unsteady flows by accounting for the mass of the charged particles. Several important particle/gas combinations are considered, namely, water droplets in air, mercury droplets in hydrogen, and polystyrene spheres in air. Additional information relating to unsteady flow electrogasdynamics is presented. (auth)

20965 DIRECT NUCLEAR CONVERSION IN 1913. Haygood, J. D. (Univ. of Tennessee Space Inst., Tullahoma). pp 1185-1189 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A method for direct conversion from nuclear power to electric power is proposed based on the work of H. G. J. Moseley in 1913. The electrons emitted by ^{90}Sr are collected on a series of aluminum foil collectors mounted in a vacuum. A capacitance motor to use the high voltage low amperage power is also presented. The specific power is estimated at 7 W per lb and the lifetime at less than 25 y. (auth)

20966 MHD: WAITING FOR SUPPORT. de Rosa, R. (Avco Everett Research Lab., Everett, MA). Energy Int.; 10: No. 1, 7-9(Jan 1973).

The operating principles, design requirements, and advantages of MHD generators are described. It is pointed out that government-industry effort in the U. S. for the commercial development of MHD technology has just begun while the USSR is beginning to operate a 25 MW pilot plant near Moscow. (LCL)

20967 INDUCTION MHD GENERATOR ELECTRICAL EFFICIENCY AT A SMALL INTERACTION PARAMETER. Katsnel'son, S. S. Magn. Gidrodin.; No. 1, 111-116(1973). (In Russian).

In the approximation of small R_m and $R_H \approx 1$, the values of the vector potential, magnetic and electric fields, and the current at the working contour of an induction MHD generator were found. The motion of the nonturbulent gas current in the channel was assigned a constant radial velocity and traveling wave of the electroconductivity. The variational problem of the detection of the maximum value of the electrical efficiency was solved numerically on the IBM computer in dependence on the parameters and geometry of the working electrical contours. The calculation results agree with the experimental data available in the literature. (tr-auth)

20968 HYDRAULIC CHARACTERISTICS OF AN EXPERIMENTAL ACTIVE TYPE LIQUID METAL MHD GENERATOR CHANNEL. Baranov, G. A.; Kirillov, I. R.; Ogorodnikov, A. P. Magn. Gidrodin.; No. 4, 112-114(1972). (In Russian).

The hydraulic characteristics of a slit channel of a liquid metal MHD generator of the active type with a dilation angle $\alpha = 12°30'$ and the distribution of the static flow along the channel without magnetic field and during interaction of the flow with a flowing magnetic field were investigated. (tr-auth)

20969 IMPROVEMENTS IN OR RELATING TO ENCAPSULATED ELECTRIC POWER GENERATORS. Myatt, J. (to United Kingdom Atomic Energy Authority). British Patent 1,318,205. 23 May 1973. Filed date 30 Jan 1970. 3p.

Reference is made to encapsulated power generators for cardiac pacemakers. Such generators are comprised of a hermetically sealed enclosure containing a heat source, a converter device for converting heat to electricity, and a heat sink. It is important to thermally insulate the region around the heat source and converter device, and ideally the space around these components is evacuated. A problem that arises, however, is the release by outgassing of gases absorbed by components within the generator enclosure. This effect is very serious where the generator is required to have a long life. In the system described Xe is employed in the generator enclosure which, in addition to having a lower thermal conductivity than air, suppresses the thermal conductivity contribution of gases released into the enclosure from surfaces of the generator components. If the air within the enclosure is replaced by Xe at or near atmospheric pressure long generator life may be secured, with a constant level of thermal insulation. Experience has indicated that it is better if the Xe is just below atmospheric pressure, for leak detection reasons. The heat source comprises a charge of ^{238}Pu contained in a small cylindrical can. (UK)

20970 ENERGY CONVERSION SYSTEM. Kittl, E. (to Secretary of the Army). U. S. Patent 3,751,303. 7 Aug 1973. Filed date 3 Jun 1971. 4p.

An energy conversion system is provided for converting thermal radiation energy into electricity. The system includes a source of thermal energy and a silicon cell spaced from the thermal energy source. A radiating solid material is positioned between and spaced from the thermal energy source and the silicon cell. The radiating solid material is capable of radiating a major portion of the heat received from the thermal energy source in the spectral band where the silicon cell shows its maximum spectral response. An interference filter is positioned between the radiating solid material and the silicon cell. The interference filter has its maximum reflectivity in the strongest emission band regions of the radiating solid material which are outside the maximum spectral response band of the silicon cell. The interference filter also has its highest transmission in the wavelength region where the silicon cell has good spectral response. (Official Gazette)

Facilities and Equipment

Refer also to abstracts 20925, 20926, 22697, 23176, 23266, 23267, 23672, 23832, 23867, 23868, and 23900.

20971 (CEA-CONF-2301) MULTISTAGE CENTRIFUGE EXTRACTORS PILOT AND INDUSTRIAL TESTS. Michel, P.; Tarnero, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 27p. (In French). (CONF-701157-1). Dep. NTIS (U. S. Sales Only) $3.50.

The tests carried out and the results obtained with the SGN-Robatel extractors are presented. The experiments began with a small flow rate nuclear apparatus, LX-168N, and were continued using a battery of 3 industrial apparatus. Tests were carried out on the hydrodynamic operation, the extraction and re-extraction of uranium, the decontamination of β and γ emitters, and U-Pu separation. (FR)

20972 (CONF-721091-, pp P31.p1-P31.p4) SOME GUIDELINES IN THE DESIGN OF A RADIOCHEMICAL LABORATORY. Smit, J. R. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The legal and practical requirements of a typical low-level radiochemical laboratory used for tracer work are reviewed. Design features that aim at minimizing the risk of contamination of working surfaces, equipment, floors etc., are discussed, and the reader's attention is drawn to a number of publications dealing with the general topic of the design of a radiochemical laboratory. (auth)

20973 (DP-MS-72-32) PROPERTY MANAGEMENT: SAVANNAH RIVER LABORATORY (POOLING OF LABORATORY AND TEST EQUIPMENT). Jones, W. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1972. Contract AT(07-2)-1. 16p. (CONF-720594-1). Dep. NTIS $3.00.

From AEC wide property management conference; Las Vegas, Nevada, USA (23 May 1973).

A method developed at the Savannah River Laboratory for the central pooling of laboratory and test equipment in order to prevent equipment duplication and delay is described. This procedure resulted in more rapid meeting of requests for laboratory equipment; selection of the most suitable equipment for proposed research and development experiments based on experience with pool-available equipment; and financial savings due to the identification of idle and unneeded portable capital equipment. (LCL)

20974 (HEDL-TME-73-41) PROTOTYPE APPLICATIONS LOOP (PAL) ONE YEAR OF OPERATIONS. Interim Report. McCown, J. J. (Hanford Engineering Development Lab., Richland, Wash). Mar 1973. Contract AT(45-1)-2170. 50p. Dep. NTIS $5.45.

The Prototype Applications Loop (PAL) has now been in operation for well over one year. Design verification and prooftesting operations have been performed on full scale prototype FFTF units of sodium and cover gas purification and characterization equipment. Details of the test work are described. (auth)

20975 (IFA-MN-14-1973) CAPSULE FOR THE CONTINUOUS MEASUREMENT OF THE DIAMETER CHANGES FOR SHORT FUEL PINS. Lungu, S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 5p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

A capsule was developed for the measurements of the diameter deformations for the temperature range from 600 to 700°C and high axial pressure (sodium cooled). A cross section of the capsule is presented. The capsule interior is filled with sodium and the capsule exterior is filled with helium. The sensitivity of the measurement of the radial deformation is of the order of 10^{-4} per degree. The range of measurement covers a variation of ±2% in pin diameter. (J.S.R.)

20976 (LA-5359-PR) AEROSOL RESEARCH AND DEVELOPMENT RELATED TO HEALTH HAZARD ANALYSIS, JANUARY 1-JUNE 30, 1973. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 29p. Dep. NTIS $4.00.

A reproducible fibrous glass aerosol has been developed and used to relate gross and "respirable" fiber mass to fiber count. Experimental data indicate a fiber mass-count relationship, and reproducible 10-mm nylon cyclone aerodynamic cutoff characteristics, suggesting the practicality of using this instrument as a "respirable" sampler for fibers. New techniques were developed for preparing permanent asbestos-filter mounts for phase contrast microscopy and transferring particulates and fibers from membrane filters to electron microscope grids. These techniques were used to develop a relationship between phase contrast and electron microscope counts of asbestos samples. A large aerosol test system was constructed with a design flow rate of 100 cfm. Development of a standard coal dust has been completed, and tests indicate its applicability for the calibration of coal mine "respirable" samplers. The effects of humidity and temperature change on the aerodynamic properties of a nonhygroscopic aerosol have been evaluated experimentally and theoretically. These effects have been considered relative to

the possible development of a sampling technique to separate fibers and non-fibrous materials. (auth)

20977 (LBL-1666, pp 376-378) DESIGN OF A HIGH TEMPERATURE NEUTRON IRRADIATION CONTAINER. Fee, D. C.; Markowitz, S. S. May 1973.
In nuclear chemistry annual report, 1972.

20978 (ORNL-TM-4163) EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF THE STRUCTURAL BEHAVIOR OF NOZZLE-TO-SHELL ATTACHMENTS. Callahan, J. P.; Greenstreet, W. L. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 78p. Dep. NTIS $6.00.
Experimental and analytical investigations of nozzle-to-shell attachments are being made under the general sponsorship of the USAEC and the Pressure Vessel Research Committee of the Welding Research Council. The Oak Ridge National Laboratory is the coordinating organization for this program. The objectives of the program are the development and verification of methods of analysis for various types of reinforced and unreinforced openings in pressure vessels, the performance of experimental and analytical studies of these openings, and the preparation of the resulting information in forms suitable for code-rule development. The studies encompass elastic and plastic behavior of individual openings and elastic behavior of closely spaced multiple openings. Participants in the studies include 11 independent organizations at 7 separate institutions. The investigations are described and program participants identified. The organization of the program, the work undertaken by each participating organization, and the work remaining to be done are covered. (auth)

20979 PREPARATION OF A TWO-LAYER DEVICE FOR DAMPING OF BENDING VIBRATION OF PLATE CONSTRUCTIONS CAPABLE OF VIBRATING AND FOR SHIELDING AGAINST ATOMIC RADIATION EFFECTS. Reinboth, K. German Patent 1,546,954. 13 Aug 1970. Filed date 18 Apr 1963. 7p. (In German).
A method for preparing a two-layer device for the damping of bending vibrations and for shielding against radiation is described. A viscoelastic and vibration-damping layer (a) is applied directly to the building part to be damped. This layer consists of a standardized, filled or unfilled polymeride based on vinyl compounds, esters of acrylic acid, or modified polyamines. A coating layer is then applied. It consists of similar polymerides, epoxy resins, saturated or unsaturated polyester resins, and the like. These contain 1.5 to 3 times the mass in powdered heavy metals, heavy metal compounds, or minerals and in addition possible low-molecular cross-linking agents such as monostyrol which have no solubility. Layer (a) in the form of a manufactured foil was cemented to the wall surface by means of an adhesive substance. Layer (a) could be applied to the wall in a liquid form and heated to a temperature of 120 to 130°C by a heatable pressure vessel with a spray pistol. The outside layer in the case of thermoplastic polymers was applied at a temperature of 150°C by means of a heating spray device. The outside layer, in the case of polymers hardening to duroplasts, was applied cold with a two-component spray pistol to layer (a). (JSR)

20980 NEW METHODS IN THE MANUFACTURE, ASSEMBLY, AND INSPECTION OF LARGE SATURATED STEAM TURBO-GENERATOR SETS, WITH PARTICULAR REFERENCE TO STADE. Bruecher, A.; Spindeldreher, F. (Kraftwerk Union AG, Muelheim am der Ruhr, Ger.). VGB Kraftwerkstechnik; 53: No. 6, 368-376 (1973). (In German).
Using the Stade Power Station as an example, the manufacture and assembly of a 600 MW saturated steam turbine are described. The dimensions of the various components are now so large that in manufacture and assembly in the works, departures from conventional practice must be accepted and new ways must be found. In addition, manufacturers and operators are making joint efforts to establish an inspection program to attain a minimum outage period. (GE)

20981 PLUGGING COMPOUND COLLECTOR. Blair, R. C.; Pohl, L. E. (to United States Atomic Energy Commission). Australian Patent 430,315. 14 Nov 1972. Priority date 2 Jul 1968, United States of America (USA).
An apparatus is described for collecting impurities in liquid metal coolants which precipitate out under prescribed temperature conditions and cause plugging of components in an associated system. (RCK)

20982 CONTINUOUS OPERATION OF HIGH TEMPERATURE AND HIGH PRESSURE HELIUM GAS TEST LOOP. Nakano, T.; Yagi, E. (Kawasaki Heavy Industries, Ltd., Japan). Nippon Genshiryoku Gakkaishi; 15: No. 5, 305-311(May 1973). (In Japanese).
A He gas test loop was constructed, to contribute to the development of the HTR. The loop was successfully operated for 110 h at a flow rate of 3.3 g/s under 1,000°C temperature and 40 kg/cm^2·g pressure. The loop is composed of a circulator, regenerative exchanger, electric heater, cooler, pressure tank and piping. The circulator is of diaphragm type, while the double tube arrangement is adopted for the regenerative exchanger, piping exposed to high temperature, and the cooler. The He temperature is raised by passing through Ta tube elements heated electrically. Operation of the loop enabled the accomplishment of most of the initial objectives, but the endurance and aging deterioration of the heater elements have yet to be confirmed. (auth)

20983 ACTUAL HEAD MODEL TEST FOR LARGE CAPACITY AND HIGH HEAD FRANCIS TYPE PUMP TURBINE. Fukumasu, K.; Inoue, S.; Mutaguchi, K.; Yamana, K.; Kotani, S. Tech. Rev., Mitsubishi Heavy Ind.; 10: No. 2, 110-119(Jun 1973).
A summary of the results of actual head model tests on a pump turbine developed for a high head large capacity pumped storage power plant with a head of 400m and a capacity of 300 MW per unit is given. The test plant used in the tests was newly built for the development of high head pump turbines and is epochmaking in scale. As the result of the test, valuable data for increasing the reliability of prototype design were obtained and at the same time, confidence was gained that no trouble will occur in prototype machines. Furthermore the results were compared with the results of performance test conducted under testing heads between 65 and 75m and the similarity law of pressure fluctuation due to difference in testing head was evidenced. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 20926, 21050, 21477, 23507, 23547, 23636, 24036, and 24037.

20984 (AEEW-M-1205) FURTHER INVESTIGATIONS INTO THE EFFECTS OF SURFACE COATINGS ON FORCED CONVECTION DRYOUT. Stevens, G. F. W.; Wood, R. W. (Atomic Energy Establishment, Winfrith (England)). May 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.
The results of an investigation on the effects on forced convection dryout of covering a heated rod with various sleeves of cotton and wire mesh are presented. The experiments were done in Freon 12 using an annular test section with vertical upflow and at a Freon pressure simulating water at 69 bar. The test section comprised a uniformly heated tube 3.66m long and 15.9mm outside diameter fixed concentrically within a shroud tube of 20.95mm bore. The results show that at certain combinations of mass velocity and inlet subcooling, the dryout power is nearly doubled by some of the mesh coverings. The annular test section with one of these coverings has also been tested in water at 69 bar and similar results have been obtained. (auth)

20985 (CONF-730803-5) FLOW FILM BOILING HEAT TRANSFER CORRELATIONS: A PARAMETRIC STUDY WITH DATA COMPARISONS. Slaughterbeck, D. C.; Ybarrondo, L. J.; Obenchain, C. F. (Aerojet Nuclear Co., Idaho Falls, Idaho). [nd]. 24p. Dep. NTIS $3.25.
From national heat transfer conference; Atlanta, Georgia, USA (5 Aug 1973).
Flow film boiling occurs in a heated channel with a flowing boiling coolant after critical heat flux has been reached and when a stable vapor film is established between the heated surface and the liquid or liquid-vapor bulk flow in the center of the channel. Because the physical phenomena associated with boiling in two-phase mixtures are not fully understood, empirical correlations are used for predicting heat transfer during these flow regimes. Five film boiling heat transfer correlations are evaluated in this analysis, and analytical data using each correlation are compared with experimental data. The five independent variables investigated for their effects on the heat transfer coefficients were: equivalent hydraulic diameter, flow pressure, wall temperature, fluid quality, and mass flow. Heat transfer coefficients were found to be insensitive to equivalent hydraulic diameter and wall temperature variations, sensitive to pressure and fluid quality, and strongly dependent on mass flow. Because of discrepancies between the different correlations and between the correlations and experimental data, it is recommended that statistical regression analysis be performed on available film boiling data to quantify the uncertainties in the prediction of applicable film boiling heat transfer coefficients and to provide a method for predicting conservative (low) coefficients. (LCL)

20986 (FEI-297) CALCULATION OF THE HEAT TRANSFER CRISIS DURING MOVEMENT OF A STEAM–LIQUID MIXTURE IN THE RING CHANNELS DURING THE DISPERSE-RING CYCLE OF

FLOW. Kirillov, P. L.; Smogalev, I. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Formulas were derived for the calculation of the heat transfer crisis in ring channels during one-sided and two-sided heating. (J.S.R.)

20987 (FEI-308) CALCULATION OF THE HEAT TRANSFER CRISIS OF A STEAM–LIQUID MIXTURE ON THE BASIS OF A MODEL OF THE DIFFUSION OF DROPS DURING CURRENT TWIST BY INTERNAL RIBBING OF THE PIPE. Kirillov, P. L.; Smogalev, I. P.; Masagutov, R. F. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The theory of the basic formulas for the calculation of the heat transfer crisis was given under the condition of current twist by the method of internal ribbing of the pipe. The calculation is based on the model of drop diffusion. (tr-auth)

20988 (KFK-1796) INVESTIGATIONS OF THE PROPAGATION OF SHOCK WAVES IN RELAXING TWO-COMPONENT BUBBLE MIXTURES. Sameith, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). May 1973. 143p. (In German). Dep. NTIS (U. S. Sales Only) $9.25.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

Research was performed on the propagation behavior of shock waves in two-component air/steam-water bubble mixtures at a pressure of approximately 1 atm and temperatures of about 25°C and 99°C, respectively. In the theoretical part of the work, the stationary integral conservation laws are formulated for the two-component system existing as a homogeneous mixture in permanent thermodynamic equilibrium. Hence the shock wave velocity can approximately be derived as an explicit function of the shock pressure ratio. The relative importance of the various thermodynamic relaxation processes is estimated. It is shown that the phase change steam-to-liquid water should be determinative for the depth of the shock front. The frozen velocities of sound are computed for the two limiting cases that either the mass transfer together with the heat transfer or only the mass transfer between the phases are completely suppressed. In the experimental investigations, which make up the central point of this work, a heated shock tube of glass with a nominal diameter of about 100 mm was used. Besides the temperature, the burst pressure and the homogeneity of the bubble mixture characterized by the void fraction together with the number of bubbles per unit volume were subjected to variations. The shock wave was traced by detection of the rapid pressure changes at five points along the wave passage using piezo-quartz pressure gauges the charges of which were amplified and recorded on a light beam oscillograph. The experimental results are discussed and compared with the theoretical statements. (GE)

20989 (MRR-119) DETERMINATION AND APPROXIMATION OF CRITICAL MASS FLOW RATES. Schally, P. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Mar 1973. 64p. (In German). Dep. NTIS (U.S. Sales Only) $5.25.

To predict critical mass flow rates the model of Moody and the homogeneous equilibrium model are often used. The derivation, the numerical calculation, and the approximation of the critical mass flow rates to predict them with the aid of the above mentioned models are discussed. The coefficients necessary for calculation of the mass flow rates are given in connection with the appropriate functions. (auth)

20990 (RD/B/N-2713) ADDENDUM TO RD/B/N–2106: EFFECT OF RIB SHAPE AND SPACING ON CONDUCTIVITY CORRECTIONS TO RIBBED SURFACE HEAT TRANSFER DATA. Watts, J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jun 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

Surface efficiency (E_∞) data correlated with modified Biot numbers (B′ and B″) are presented. Using these correlations, rig-to-reactor conductivity corrections to the heat transfer performances of rib-roughened surfaces can be determined without the inconvenient iterative procedure required when using the original correlation. (auth)

20991 (RISO-M-1623) BURN-OUT, CIRCUMFERENTIAL FILM FLOW DISTRIBUTION, AND PRESSURE DROP FOR AN ECCENTRIC ANNULUS WITH HEATED ROD. Andersen, P. S.; Jensen, A.; Mannov, G.; Olsen, A. (Danish Atomic Energy Commission, Risoe. Research Establishment). May 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

Measurements of burn-out, circumferential film flow distribution, and pressure drop in a 17 by 27.2 by 3500 mm annulus geometry are reported. The eccentricity was varied from 0 to 3 mm. The pressure and rod heat flux were held constant at 70 bar and 100.7 W/cm^2. Burn-out curves are presented for mass velocities between 200 and 1500 kg/m^{2}s and for inlet subcoolings of 10°C and 100°C. The film flow and pressure drop measurements correspond to the steam qualities $x \doteq 19\%$ and 24% for the mass velocity G = 602 kg/m^{2}s and $x \doteq 20\%$ and 23% for G = 1200 kg/m^{2}s. The influence of the circumferential rod film flow variation on burn-out is discussed. (auth)

20992 (SCPRI(RM)-3-1973) REPORT OF ACTIVITY, MARCH 1973. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 1973. 14p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

This monthly report of the SCPRI presents results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), seawater around nuclear plant sites and other sites. (CH)

20993 (SU-326-P-13-7) BUBBLE NUCLEATION BY FAST NEUTRON RECOIL ATOMS IN SUPERHEATED ETHYL ALCOHOL AND WATER. Pilati, D. A. (Stanford Univ., Calif. Dept. of Mechanical Engineering). Dec 1972. Contract AT(04-3)-326. 141p. Dep. NTIS $9.25.

Thesis.

The radiation-induced nucleation phenomenon was investigated to determine the significance of ionizing radiation in a nuclear reactor environment. A bubble chamber was used to study the behavior of ionized knock-on atoms, produced by fast neutrons colliding with constituents of the liquids, in superheated ethyl alcohol and water. The theory, equipment, procedures, and performance of the experiment are described. Bubble production in ethyl alcohol and water at several temperatures were predicted and compared with the data obtained. The experiments proved that it is possible to observe bubbles nucleated by neutron-recoil oxygen and/or carbon atoms in superheated ethyl alcohol and water. In alcohol the superheat at which nucleation was observed varied from 2.5 to 20.5°F over a temperature range from 269 to 407°F. In water, the superheat was about 17.5° at a temperature of about 535°F. Although the theory was useful in predicting observed nucleation conditions, experimental data suggests that the theory must be modified because the slope of the experimental superheat-versus-temperature curve for a particular bubble production was consistently in disagreement with the predicted slope and because the theory does not deal with the effect of dissolved gases on the superheat required. Development of a bubble chamber in which the gas content of the liquid could be maintained is recommended for a more complete study of dissolved gas effects. The results in water indicate that the existence of bubbles which are not produced by radiation may be more important in reactor-coolant void production than those bubbles which are produced due to the presence of radiation. (LCL)

20994 (SU-326-P-13-8) STUDY OF ALPHA-, LITHIUM-7-, AND FISSION-FRAGMENT-INDUCED BUBBLE NUCLEATION IN SUPERHEATED LIQUIDS. Whitehouse, H. T. Jr. (Stanford Univ., Calif. Dept. of Mechanical Engineering). May 1973. Contract AT(04-3)-326. 154p. Dep. NTIS $9.75.

Thesis.

In light-water reactors there are a number of kinds of ionizing radiation in the coolant which, given some superheat, can induce bubble nucleation. These include fission fragments from any stray uranium carried in the primary water, recoil ions from the collision of fast neutrons with hydrogen and oxygen, and lithium-7 ions and alpha particles formed in the $^{10}B(n,\alpha)^7Li$ reaction. (Boron compounds are often used for shim control.) The coolant might become locally superheated near a cladding wall which is above the liquid's saturation temperature, or experience more widespread superheating due to a sudden loss of system pressure. Under these superheated conditions, radiation-induced nucleation could very well overshadow the conventional surface nucleation mechanisms. Since massive coolant boiling (voiding) is closely tied to reactor safety problems, the present investigation was performed to determine experimentally the threshold conditions for radiation-induced nucleation in superheated water and ethanol. (TFD)

20995 (UCID-16303) TRANSIENT COMPRESSIBLE FLUID FLOW OF CONDENSABLE GAS MIXTURES IN LONG VERTICAL CRACKS. Rozsa, R. B. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Jul 1973. Contract W-7405-eng-48. 14p. Dep. NTIS $3.00.

A mathematical model is used to calculate the transient fluid

flow of steam, air and liquid water mixtures in a vertical crack. The flow is described by use of equations of continuity, momentum, energy, and state. The fluid is assumed to be a homogeneous mixture with simple volume-averaged transport coefficients. Sample calculations are presented for flow in a 0.1-in. wide annular crack 6000 ft long. The effect of water to air ratio is investigated for constant driving source conditions of 370°C and 2000 psia total pressure. As the ratio of water to air is increased the flow is retarded. In the extreme case of almost all water, the flow eventually stops when the pressure gradient is balanced by the gravity forces. (auth)

20996 RECOMMENDATIONS FOR COMPUTING THE HEAT TRANSFER COEFFICIENT IN TWO-PHASE STEAM–WATER FLOW IN THE PIPES OF A STEAM GENERATOR. Andreevskii, A. A.; Borishanskii, V. M.; Fokin, V. S.; Fromzel, V. N.; Danilova, G. P.; Bykov, G. S.; Chistyakov, V. A. Heat Transfer–Sov. Res.; 5: No. 3, 130-136(1973).

The complexity of calculating heat transfer with two-phase flow through steam generator pipes is reviewed. Experiments were performed to obtain data on wall temperature distribution with a given thermal loading and with two-phase flow having fixed parameters. Two relationships from current literature were selected for calculating such heat transfer and the calculated heat transfer coefficients were compared with test data. One expression was valid for the region of relatively low steam content and the other for high steam content (high velocity flow). From these and the test data, the dependence of the heat transfer coefficient on the flow velocity and on the thermal load was determined and a single expression was derived which is correct for subcritical regimes of heat transfer and which was collaborated by test data in the following range of parameters: pressure from 2 to 170 kg/cm^2 and heat transfer rate from 70×10^3 to 5×10^6 kcal/m$^2 \cdot$ hr. (LCL)

20997 WEAK SHOCK WAVES IN BOILING WATER AND GAS–LIQUID SUSPENSIONS. Neshchimenko, Yu. P.; Suvorov, L. Ya. At. Energ. (USSR); 33: No. 1, 573(Jul 1972). (In Russian).

This paper was summarized as paper No. 591/6553 with full copy held by TIC.

The working fluid of a boiling thermal reactor is a two-phase mixture in which nonstationary processes like shock waves can occur. Results of modeling the propagation of weak shock waves in boiling water, water with steam and air bubbles, water with air or helium bubbles, and also in glycerin with air bubbles are presented. Measurements were made on the velocity of the shock wave and density jump as functions of the shock strength and the initial density and composition of the mixture. The structure of the shock transition was studied. The dispersed vapor–gas–liquid mixture was regarded as continuous and moving with uniform velocity. The equation for the adiabatic curve of the shock wave is written approximately as $V_0 - V = xV_{01}\, p - p_0/p + y(V_{02} - V_3)$, where x and y are the parts by mass of gas and vapor in the mixture; V_{01}, V_{02}, and V_3 are the specific volumes of gas, vapor and liquid in the original mixture; and V and p are the specific volume and pressure behind the shock front respectively. This equation is a generalization of the equation for the case of phase transitions. Under the action of the shock wave condensation of the vapor bubbles and fractionation of the gas bubbles occur. The width of the wave in boiling water depends on the condensation rate of the steam. The structure of the shock front in a gas–liquid suspension depends on the mechanical and thermal interactions of the components. The rate of heat exchange depends in an essential way on the properties of the gas. Properties of the liquid component has only a slight influence on the shock wave parameters. When a shock wave is reflected from a gas–mixture interface, after impinging on it from the gas side, the interface can be regarded as undeformed. Corrections for the compressibility of the mixture and the scattering of the wave from the rough interface does not fall outside the limits of accuracy of the measurements. When a shock wave, propagating in a mixture, is reflected from a rigid wall the pressure jump across its front is approximately doubled. (auth)

20998 ADVANCES IN HEAT TRANSFER. Volume 9. Irvine, T. F. Jr.; Hartnett, J. P. (Eds.). New York; Academic Press, Inc. (1973). 445p. $26.50.

This textbook on heat transfer includes information on advances in thermosyphon technology; heat transfer to flowing gas-solid mixtures; condensation heat transfer; natural convection flows and stability; and cryogenic insulation heat transfer. (LCL)

20999 EXPERIMENTAL STUDY OF THE EFFECT OF CROSSED ELECTRICAL AND MAGNETIC FIELDS ON THE FLOW AND HEAT TRANSFER CONDITIONS AT A PERMEABLE PLATE ON INJECTION OF AN ELECTRICALLY CONDUCTING FLUID. Eroshenko, V. M.; Motulevich, V. P.; Sopikov, V. A.; Starostin, A. D. (Krzhizhanovskii Energetics Inst., Moscow). Heat Transfer–Sov. Res.; 5: No. 4, 82-85(1973).

An experimental study is described of the effect of crossed electric and magnetic fields on the hydrodynamics and heat transfer at a permeable plate during the injection of an electrically conducting fluid. The latter, in the case at hand, was a 15% solution of KOH. The magnetic system was rated at 1.3 tesla. The velocity was determined by a tracing method in which the tracers were graphite particles, introduced into both the primary and secondary fluids. Curves are presented of four flow regimes: without and with injection and two others with a MHD force acting on an electrically conducting injected fluid. It was found that injection imparts an S shape to the velocity distribution and increases the boundary layer thickness. Imposition of the three-dimensional MHD force increases the flow velocity and heat transfer to the wall and reduces the boundary layer thickness when directed along the longitudinal velocity and decreases the velocity in the injected layer, and increases the size of separation zone. The boundary layer is found to separate on attaining some magnitude of the MHD force. The electrical current flowing through the injected fluid was found to interact with the magnetic field, restructure the wall flow and thus affect the heat flux to the wall. (auth)

21000 STUDY OF STARTUP REGIMES OF HIGH-TEMPERATURE HEAT PIPES. Tolubinskii, V. I.; Shevchuk, E. N.; Chistop'yanova, N. V.; Stambrovskii, V. D.; Zaichenko, A. P.; Kurikhin, V. I. (Kiev Inst. of Engineering Thermophysics). Heat Transfer–Sov. Res.; 5: No. 4, 156-162(1973).

An experimental study is described of the startup regimes of heat pipes. The experiments were carried out with a short as well as long pipe in two specially designed facilities. It was determined that best startup conditions are attained by preheating the pipe to from 400 to 500°C. It was found further that, barring wick dryout, the sonic limit on the amount of heat to be transferred is overcome under any startup conditions. This makes it desirable to select a wick structure such that the heat transfer limit governed by the pressure drop be much higher than the sonic limit at starting temperature. This, in turn is attainable by maintaining the maximum evaporator temperature at the 600°C level. Experimental results are represented graphically. (auth)

Materials Testing

Refer also to abstracts 23990 and 24017.

21001 (APDA-M-72-132) INSTRUCTION MANUAL FOR ULTRASONIC TRANSDUCER EQUIPMENT FOR UNDER SODIUM SCANNING. Matte, J. III.; Toth, W. L.; Ziniuk, M. A. (Atomic Power Development Associates, Inc., Detroit, Mich.). Aug 1972. 52p. Dep. NTIS $4.75.

An instrument package to be used in the ultrasonic testing of materials under sodium is described in detail. Information is given on the individual transducer elements, including design drawings; the quality assurance program used to assure that the transducer and electronic instrumentation comply with design specifications; and operating characteristics and instructions. (LCL)

21002 (CONF-721091-, pp R19.b1-R19.b3) GAMMA RADIOGRAPHY. Otto, A. C. H. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

During the late fifties the first isotopes for industrial radiographic purposes were imported into South Africa. This marked the beginning of the technique for the testing of various metal products for defects by using isotopes as source of radiation. During the years that followed a gradual increase as well as a refinement of techniques resulted while cobalt-60, cesium-137, and iridium-192 were extensively used. Because cesium-137 produces no better results than cobalt-60, this isotope is no longer used. Like all other methods, industrial radiography can only ensure results if factors like geometric unsharpness, type of defect that must be detected, and films to be used are taken into account. Within the next few months cobalt-60 and iridium-192 will be produced at Pelindaba. Industry must make use of techniques such as radiography to ensure that quality products reach the export market a factor of vital importance to the future of South Africa. (auth)

21003 (CONF-731003-3) STRESS DISTRIBUTION OF A CYLINDRICAL SHELL NONRADIALLY PENETRATED INTO A SPHERICAL PRESSURE VESSEL. Yu, J. C. M.; Chen, C. H.; Shaw, W. A. (Auburn Univ., Ala. (USA). Dept. of Mechanical Engineering). [nd]. 39p. Dep. NTIS $4.00.

From second international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

For Oak Ridge National Lab., TN.

The results of the stress distribution of a cylindrical shell non-radially penetrated into a spherical shell under internal pressure are given. The compound-shell is separated along the junction curve into two cylindrical shells and a spherical shell. For small angles of inclination the junction curve can be approximated as a plane curve. Consideration of larger angles of inclination where the approximation is not valid is included. The continuity conditions along the junction curve are satisfied by the method of least square boundary point matching. Numerical results of the stresses at the outer and inner fibers of the compound-shell at different locations have been obtained and plotted into curves. Comparison of the stresses of the compound-shells with and without intrusions was made and it was found that they differ only in quantity and no pronounced deviation in nature is observed. (auth)

21004 (KFK-1542) NEUTRON RADIOGRAPHY BY MEANS OF Cf 252. Kathol, W. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1973. 71p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

Neutron radiography is a technique of representing objects with the help of neutrons. It resembles x-ray and gamma radiography in many respects, although it can supplement these techniques remarkably in some cases. Possible applications are in biology/medicine and in non-destructive material testing. Cf-252 allows the construction of transportable neutron radiographic devices which can be employed in various laboratories. With an appropriate design, this device can be utilized also to activate samples for activation analyses. (GE)

21005 (ORNL-TM-4285) RADIOGRAPH INTERPRETATION WITH CLOSED-CIRCUIT TELEVISION. Foster, B. E.; Snyder, S. D.; McClung, R. W. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 18p. AT.

The use of closed-circuit television for enhanced viewing and interpretation of radiographs was studied. Addition of microscope lenses to the television camera and simple electronic modules as peripheral equipment resulted in a relatively inexpensive but quite versatile system. Selected areas on the television monitor can be shaded for improved contrast or more comfortable viewing. Any section of any line of the television raster can be displayed on an oscilloscope or recorded with enhancement on an x−y recorder. Among examples of applications are the magnified viewing of a radiograph of a 400-mesh screen, detection of a crack in a 30-μm-dia wire, detection of flaws in welds, and accurate measurement of dimensional change within a few mils in a complex radiograph. (auth)

21006 (RISO-M-1599) LINEAR ACCELERATOR RADIOGRAPHY. Domanus, J.; Hansen, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1973. 97p. Dep. NTIS (U. S. Sales Only) $7.00.

A description is given of the Risø 10-MeV linear accelerator, which was used for radiography of steel (50 to 250 mm thick). Different x-ray film and intensifying screen combinations were tested and characteristic curves and exposure charts were computed. X-ray film speed and contrast were calculated. Radiographic image contrast and quality were investigated and the best combination of x-ray film and screen was chosen. Conclusions were drawn about the possibility of using the Risø accelerator for industrial radiography. (auth)

21007 REFERENCE MARKER FOR NONDESTRUCTIVE INSPECTION TECHNIQUES. Proctor, E. S. Jr. (to Combustion Engineering, Inc.). U. S. Patent 3,733,889. 22 May 1973. Filed date 26 Aug 1970. 3p.

A reference marker for use in conjunction with volumetric inspection techniques on nuclear reactor pressure vessels is described. A block of material having a sharp corner geometry is provided at particular locations on the vessel structure to be inspected. The block of material then serves as a physical location reference marker and/or means for use in calibration of the volumetric inspection device. (Official Gazette)

21008 INDUCED ACTIVITY OF STEEL ARTICLES FOLLOWING THE BETATRON RADIATION TEST. Vasnin, G. M.; Golikov, E. G.; Sukhanova, K. A. (Ural Polytechnic Inst., Sverdlovsk, USSR). Defektoskopiya; No. 3, 75-79(1973). (In Russian).

The results of the experimental investigation of the time and energy characteristics and constituents of the emission of the induced activity of steel samples of different chemical composition were reported. (tr-auth)

21009 EMPLOYMENT OF A MINIATURE PMB-6 BETATRON FOR INTROSCOPY OF STEEL PRODUCTS. Groshev, V. Ya.; Krasnousov, V. P.; Nedavnii, O. I. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 3, 79-81(1973). (In Russian).

The possibility of using the PMB-6 betatron for the introscopy of steel products was experimentally established. A block diagram and a description of the introscope are given. Principles of the storage of information are reported. Experimental results of parametric studies of the performance of the betatron are given. (tr-auth)

21010 DETERMINATION OF PHOTOGRAPHIC EXPOSURE FOR FLAW DETECTION BY THE RADIATION METHOD. Ivanov, V. A.; Slobodenyuk, V. N. Defektoskopiya; No. 3, 81-83(1973). (In Russian).

The possibility of determining the sensitivity of x-ray film to different types of radiation sources was examined. Formulas were derived for the dependence of the time exposure for a given photographic sensitivity on the dose output of the emitter behind the investigated element. (tr-auth)

21011 RADIATION FLAW DETECTOR WITH PROJECTION DISPLAY FOR INSPECTION OF ARTICLES MADE FROM NON-HOMOGENEOUS MATERIALS. Vorob'ev, V. A.; Kivran, V. K.; Filonin, O. V. (Tomsk Polytechnical Inst., USSR). Defektoskopiya; No. 3, 129-132(1973). (In Russian).

A radiation flaw detector with projection display is described. A kinematic circuit is given of the scanning device. A block diagram is given of the channel for processing the input signal. (JSR)

21012 SCINTILLATION GAMMA FLAW DETECTOR SET FOR TESTING WELDS. Gostishchev, V. S.; Kostenich, V. N.; Nosova, G. M.; Neporozhnii, I. T. Defektoskopiya; No. 3, 133-135(1973). (In Russian).

The scintillation flaw detector described previously (Defek., 1970, No. 6, 140) was investigated using ^{137}Cs as the radiation source. Calculations were made to determine the sensitivity under different conditions. The results are tabulated and show that the installation gives satisfactory sensitivity on thicknesses greater than 30 mm. Calculations made for ^{192}Ir showed that for thicknesses up to 30 mm the installation gave the necessary sensitivity. (JSR)

21013 AUTOMATIC TESTING SYSTEM FOR SPHERICAL FUEL ELEMENTS. Gutknecht, W.; Pies, W. (Philips Forschungslaboratorium GmbH, Hamburg). Materialpruefung; 15: No. 7, 229-232(1973). (In German).

A technique for testing nuclear fuel elements is described which is performed by scanning the test specimen by means of a narrow x-ray beam. The scanning is achieved by rotating the object around two axes. The false-alarm rate is reduced by means of analog and digital signal processing. (GE)

21014 APPLICATION OF GROUP TESTING PROCEDURES IN RADIOLOGICAL HEALTH. Thomas, J.; Pasternack, B. S.; Vacirca, S. J.; Thompson, D. L. (State Univ. of New York, Brooklyn). Health Phys.; 25: No. 3, 259-266(Sep 1973).

A "group test" is a simultaneous test on x units selected from a total of N, where $1 \leqq x \leqq N$ and all N units are to be tested. The result of the test can be that all (x) units tested are good or that at least one of the (x) units is bad—in which case, a rule must exist for determining the sizes of the subsequent test-subgroups. A prime consideration in adopting such a procedure might be an attempt to reduce the total number of tests required to classify all (N) units in the set. Group testing procedures have found application in such varied areas as (a) blood-testing and (b) testing helium sealed electrical devices. In this paper, it is shown that group testing of large inventories of sealed radioactive sources is more efficient than the other commonly used methods. Further, it is shown that for a given subset of sealed sources containing a single defective source, the "halving" or "binary-batching" approach leads to the least number of tests. Consideration is also given to the case where (a) there is no a priori information on the probability that a source is defective and (b) the result of a single group test indicates at least one defective unit in the group. The efficiency associated with the application of group testing to sealed sources results in a reduction in radiation exposure to personnel. Other possible applications of group testing procedures in radiological health are also discussed. (auth)

21015 METHOD FOR COMPARISON OF NEUTRON RADIOGRAPHY SYSTEMS. Barton, J. P.; Klozar, M. F. (Argonne National Lab., IL). Mater. Eval.; 31: No. 9, 169-178(Sep 1973).

A test object that can be neutron radiographed to provide a direct comparison between different neutron radiography systems is described. The test object is three dimensional and is comprised of sets of wires, holes and absorber squares. It is necessary to take only one or two radiographs using standard conditions and then

evaluate the negatives by means of visual inspection and densitometer readings. Results of the test can be presented graphically or numerically. The development of the test object (System Image Quality Indicator, SYQI) and results of its use in various conditions are presented. (auth)

21016 NON-DESTRUCTIVE DETECTION PROCESS FOR NUCLEAR FUEL RODS. Grossman, L. N. (to General Electric Co.). U. S. Patent 3,742,367. 26 Jun 1973. Filed Date 22 Sep 1970. 8p.

A method of detecting moisture and reactive gases in assembled nuclear fuel rods is disclosed in which an alloy of zirconium, nickel and titanium is added to the fuel rod. The fuel rod is uniformly heated for a sufficient time to vaporize moisture in the fuel rod enabling reaction between the alloy and the moisture and reactive gases. The presence of reaction products containing hydrogen can be detected by neutron radiography. (Official Gazette)

21017 RADIOGRAPHIC IMAGE ENHANCEMENT BY SPATIAL FREQUENCY FILTERING. Hesse, P. W.; Griscuolo, E. L.; Polansky, D. (Naval Ordnance Lab., Silver Springs, MD). Brit. J. Non-Destruct. Test.; 15: No. 4, 101-107(Jul 1973).

From NDT 1972 conference; Loughborough, England (Sep 1972).

Detail in a radiograph is composed of a super-position of a number of spatial frequencies. These frequencies arise from the object, image unsharpness, and scatter. Spatial Fourier filtering of a radiograph provides a unique method of eliminating those frequencies that contribute to unwanted detail or unsharpness. Experimental work was performed with optical Fourier transform enhancement on industrial radiographs. The effects of simple filters were demonstrated. (auth)

Nuclear Explosions

Refer also to abstracts 20995, 21069, 21153, 21405, 22080, and 22129.

21018 (AD-753420) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 8. Preliminary Network Evaluation Studies. Alsup, S. A. (Texas Instruments Inc., Dallas). 30 Apr 1972. Contract F33657-71-C-0843. 49p. NTIS.

Theoretical single-station and network signal detection capability models for surface waves are given. Application of these models to world-wide signal detection capability by the Very Long Period Experiment stations and the ALPA, NORSAR, LASA arrays show high probability of at least 2-station detection at about Ms = 3.0 to 3.1 for most of Eurasia for both 20- and 40-second Rayleigh waves. More rapid attenuation of the 40 second wave amplitudes with distance compared to 20-second amplitudes is demonstrated and included in the theoretical capability model. Evaluation of a network of such stations to decrease problems in detection, unmixing of signals, and evaluating source radiation pattern effects is discussed. (auth)

21019 (AD-756256) GROUND SURFACE WAVES. Final Report. Yang, I. M. (Tetra Tech., Inc., Pasadena, Calif.). Feb 1973. Contract DNA001-72-C-0074. 51p. (TETRAT-P-260-73-1; DNA-3022-F). NTIS.

An approach is presented which provides an explanation of the appearance of concentric ridges at some explosive test sites. This investigation showed that the gravity effect on ground motion was important only for media with very low rigidity. This and the local soil condition suggest that the soil at those test sites might have been liquefied during a short time just after an explosion. Based on this assumption, a mathematical model was formulated and the results were in good agreement with the data observed in the Prairie Flat test. (auth)

21020 (AD-756350) PROJECT BUCKBOARD, GROUTING SUPPORT. Bendinelli, R. A. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Apr 1961. 11p. NTIS.

In Project BUCKBOARD, high-explosive charges were detonated in basalt to determine their earth-moving ability in this type of formation. One shot (shot 12), a 40,000-lb charge of spherically shaped TNT placed 43 ft below ground surface in an 11-ft-diameter cavity at the bottom of a 4-ft-diameter drilled hole, was to be used for ground-motion studies. The Waterways Experiment Station determined pertinent physical properties of the basalt and developed a grout mixture with matching properties for use in grouting earth-motion measuring instruments into eight holes drilled near shot 12; grouted the instrument holes; and from specimens of the field-mixed grout determined its physical properties at shot time. The grout required a high water content to be pumpable; consequently its compressive strength and ultrasonic pulse velocity were less than desired. (auth) 9/14 3

21021 (AD-756448) GROUND MOTIONS FROM HIGH-EXPLOSIVE EXPERIMENTS. Final Report. Ingram, L. F. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Dec 1972. 39p. NTIS.

Ground shock data from recent large, near-surface high-explosive tests are reviewed. Emphasis is on close-in motions in rock. Wave forms are shown for selected shots and locations. Comparisons are made among wave forms for similar test conditions in different geologic materials including soil, shale, granite, and sandstone. Variations in peak motion amplitudes at various depths and ranges are discussed for the different geologic materials. (auth)

21022 (AD-758225) THEORETICAL EFFECT OF YIELD AND BURST HEIGHT OF ATMOSPHERIC EXPLOSIONS ON RAYLEIGH WAVE AMPLITUDES. Harkrider, D. G.; Newton, C. A.; Flinn, E. A. (Teledyne Geotech, Alexandria, VA (USA)). 14 Feb 1973. Contract F44620-69-C-0082. 76p. (AL-72-3; AFOSR-Tr-73-517). NTIS.

Theoretical seismograms for fundamental mode Rayleigh waves were calculated for atmospheric point sources over oceanic and over continental earth models, as recorded at an epicentral distance of 10,000 km. Yields were uniformly distributed over the range 1 kT to 10 MT, for source altitudes in the range 0.3 to 92.0 km. The earth structures used were those of Gutenberg and of Anderson and Toksoz. The source models were point mass-injection and energy-injection sources at altitude, as well as a distributed pressure pulse at the surface of the earth. (auth)

21023 (AD-759086) JOHNIE BOY CRATER CALCULATIONS. Final Reports, October 1971–October 1972. Maxwell, D. E. (Physics International Co., San Leandro, Calif.). Apr 1973. Contract DNA001-72-C-0008. 74p. (PIFR-365; DNA-3048-F). NTIS.

A two dimensional plastic-elastic computation of the JOHNIE BOY cratering event was performed. The material model was constructed from average alluvium properties at other NTS sites. Advanced computer techniques made it possible to compute to 0.8 second of real time at a modest expenditure of computer hours. The computed crater was slightly larger than that of the experiment. The computed ground motion, however, failed to predict the rebound feature recorded by the experiment velocity gages. (auth)

21024 (AD-759383) SIMULATION OF NUCLEAR BURSTS AT THE SURFACE OF WATER BY THE IMPACTION OF MOLTEN METAL DROPLETS. Final Report (Volume 1). Kriebel, A. R. (URS Research Co., San Mateo, Calif.). Apr 1973. Contract N00014-72-C-0225. 26p. (URS-7207-2). NTIS.

A series of experiments to investigate the feasibility of obtaining an explosive chemical reaction from a molten droplet of aluminum or magnesium impacted on water is described. None of the tests produced such an explosion, but the test conditions and results add to the available information on the hazards from inadvertent spills and the conditions required to produce a metal–water explosion. The objective of the study was to assess the feasibility of laboratory simulation of a nuclear burst at a water surface by the impaction of a molten metal droplet exploding on contact with water. (auth)

21025 (AD-759549) THEORETICAL CALCULATION OF ACOUSTIC–GRAVITY WAVE EXCITATION BY NUCLEAR EXPLOSIONS IN THE ATMOSPHERE. Newton, C. A.; Flinn, E. A.; Harkrider, D. G. (Teledyne Geotech, Alexandria, Va. (USA)). 5 Mar 1973. Contract F44620-69-C-0082. 36p. (AL-72-4); AFOSR-TR-73-714). NTIS.

From theoretical calculations of acoustic-gravity waves in the period range from 40 to 1,000 s from various combinations of yield and burst height, it is concluded that the power varies as the square of the yield for low-altitude explosions and as the two-thirds power for altitudes above 100 km. For a given yield, the power increases with burst height to a maximum which is found at lower altitudes for higher yields. The effect of variable atmospheric structure along the propagation paths renders it possible to make only a rough estimate of yield and no meaningful estimate of burst height. The study also shows that all of the first ten modes are always relatively well excited so that the relative modal structure of a signal is not a good diagnostic for burst height. (auth)

21026 (AD-759743) NMCSSC SIMULATION FOR THE ASSESSMENT OF TACTICAL NUCLEAR WEAPONS (SATAN II): SYSTEM DESCRIPTION. Computer System Manual. Lautzenheiser, M.; Bales, W. B.; Fletcher, N. H.; Eoff, D. A.; Koehler, R. B. (National Military Command System Support Center, Washington, D. C.). 5 Jan 1973. 342p. (NMCSSC-CSM-SD-133-72). NTIS.

The SATAN 2 System Description (SDM) provides a description

of the SATAN 2 Model and its operations. SATAN 2 is a model for the two-sided, open play of tactical nuclear weapons exchanges on simulated battlefields. When provided by the user with description of the engaging forces, rates of target acquisition, and a nuclear weapons employment doctrine, the SATAN 2 computer programs will automatically: establish the battle area, deploy the forces, determine necessary reaction for actions taken, acquire targets, allocate nuclear weapons to fire on those targets, assess the effects of those fires, move the forward edge of battle area (FEBA), and automatically interface with ALAS (A Tactical, Logistical, and Air Simulation). (auth)

21027 (AD-760769) DIGITAL ANALYSIS OF MICROBAROGRAPH DATA. Report for 1 March 1969–31 March 1972. Kerr, J.; Skefington, P. F.; Flinn, E. A.; Smart, E. (Teledyne Geotech, Alexandria, Va. (USA)). 9 Mar 1973. Contract F44620-69-C-0082. 69p. (AL-72-6; AFOSR-TR-73-862). NTIS.

The results of analysis of microbarograph records from two presumed atmospheric nuclear explosions are given. The events occurred on Dec. 27, 1968 and Sept. 29, 1969, and were recorded by microbarograph arrays in Boulder, Colorado, College, Alaska, Huancayo, Peru, Tel Aviv, Israel and at LAMA, and the Large Aperture Microbarograph Array in Montana. LAMA data and analysis results for eight other presumed explosions are also presented. In addition to demonstrating the effectiveness of the digital detector, the purpose of the report is to make the calibrated data and spectral calculations available to other workers in this field. (auth)

21028 (EERL-MP-E-73-3) ANALYSIS OF GROUND-MOTION PEAK PARTICLE VELOCITIES FROM CRATERING EXPERIMENTS AT TRINIDAD, COLORADO. Tami, T. M. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). May 1972. 57p. Dep. NTIS $5.00.

Peak particle velocities, obtained from 76 ground-motion records from 38 explosive excavation events at Trinidad, Colorado, are tabulated and numerically analyzed. These events had explosive yields ranging from 1 to 68 tons; some were single-charge events, while one had 48 charges arranged in a three-dimensional array. An empirical expression (evaluated by regression analysis techniques) shows that peak particle velocity: (1) decreases with distance, r, as $r^{-1.87}$, (2) increases as the 0.74 power of a detonation's simultaneous yield, and (3) increases or decreases depending on whether the detonation's scaled depth of burial, dob, is greater or smaller than the optimum for cratering [i.e., peak velocity varies as exp [0.06 (dob – 20)]]. All measured velocities are scaled to a yield of 1 ton and, by a new scaling function, to a dob of 0 ft/ton$^{1/3}$; these scaled velocities are within a factor of 2.5 of those given by the empirical expression that was obtained. Two multiple-charge detonations serve to verify this empirical expression. The dependence of peak particle velocity on the simultaneous yield of a detonation, rather than on the total yield, indicates that a significant reduction in seismic motion amplitude can be achieved by means of time delays greater than 25 ms between explosive charges or between groups of charges. (auth)

21029 (EERL-TR-E-73-1(Rev.)) PROJECT TRINIDAD. Explosive Excavation Tests in Sandstone and Shale. Redpath, B. B. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Jul 1972. 108p. Dep. NTIS $5.45.

A series of single-, row-, and multiple-charge cratering detonations, with individual charge weights of from 1 to 2 tons, were carried out in weak, interbedded sandstones and shales near Trinidad, Colorado during 1970 and 1971. The principal objectives of these excavation experiments were to obtain single-charge cratering curves, to verify row-charge designs for achieving a specified excavation, to determine the effects of millisecond delays in row-charge cratering, to experiment with cratering in varying terrain, and to compare the cratering effectiveness of several explosives. Three varieties of aluminized ammonium-nitrate blasting agents and ANFO were used. Airblast and seismic effects of each detonation were monitored. The series culminated with the excavation of a railway cut 400 ft long with 44 tons of explosives distributed among 32 charges. (auth)

21030 (EERL-TR-E-73-2) MILITARY ENGINEERING APPLICATIONS OF COMMERCIAL EXPLOSIVES: AN INTRODUCTION. Briggs, J. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Oct 1972. 163p. Dep. NTIS $7.60.

Explosive excavation is a relatively new technology for creating barriers, destroying targets, and constructing military aids (e.g., bunker emplacements) in the theater of operations. This technology stems from research in explosive excavation performed since 1962. It is acknowledged that the military engineer is in need of a military engineering tool that will satisfy his earth-moving requirements and increase his ability to defeat the enemy in less time, with fewer men, and with less equipment. The advantages of various bulk commercial explosives with the Army's arsenal of conventional explosives are compared. Large-scale excavation with bulk explosives shows overall cost and time benefits. Two military related experiments utilizing bulk explosives are presented with an evaluation of the associated cost and time savings. The mechanism of crater formation, the characteristics of explosively produced craters, and the types of projects in which craters would be useful in the theater of operations (e.g., tank traps, bridge destruction) are described. Design procedures for the emplacement of single charges and multiple charges for row craters are provided. Geologic media and a variety of drilling techniques are discussed. Research is required to further develop commercial explosives for military applications. (auth)

21031 (FOA-4-4505-A-1) NUCLEAR EXPLOSIONS 1945–1972, BASIC DATA. Zander, I.; Araskog, R. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Apr 1973. 56p. Dep. NTIS (U. S. Sales Only) $5.00.

A survey of nuclear tests conducted from 1945 to 1972 is presented. Up to and including April 25, 1973, a total of more than 925 nuclear tests of different types are very likely to have been conducted. More than 425, that is nearly half the total, have been conducted after the signing of the Partial Test Ban Treaty of Aug. 5, 1963. Mass showing the location of the shots are presented. The dates, countries, locations, name, type of burst, and yields for the shots are given in tabular form. (TFD)

21032 (FOA-4-4543-A-1) EXPLOSION IN WESTERN USSR, SEPTEMBER 4, 1972. Hagfors Event Report No. 8. (Hagfors Observatory, Stockholm (Sweden)). Jul 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

Seismic data recorded at the Hagfors Observatory in Sweden from an explosion in Western USSR on Sept. 4, 1972 are presented. The data includes short- and long-period signals and their spectra. (auth)

21033 (FOA-4-4544-A-1) US NUCLEAR EXPLOSION RIO BLANCO, MAY 17, 1973. Hagfors Event Report No. 9. (Hagfors Observatory, Stockholm (Sweden)). Jul 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

Seismic data recorded at the Hafgors Observatory in Sweden from the Rio Blanco Event are presented. The data includes short period signals and their spectra. Because of interfering waves from an earthquake no long period signals could be detected. (auth)

21034 (NVO-126) EFFECTS EVALUATION AND DOCUMENTATION PLAN FOR PROJECT RIO BLANCO. (Nevada Operations Office (AEC), Las Vegas. Office of Effects Evaluation). Apr 1973. 157p. (PNE-RB-49). Dep. NTIS $10.00.

Reviews of Project Rio Blanco by five Nevada Operations Office (NV) groups are presented. The Containment Evaluation Panel (CEP) reviewed the containment aspects (probability of accidental release of radioactivity to the atmosphere) of the project. The NV Panel of Consultants reviewed the ground motion, structural response (including man-made and natural structures), natural seismicity and aftershocks, geology, hydrology (including groundwater contamination effects), and environmental aspects, and the effects on other mineral resources in the Piceance Creek Basin. The Nuclear Safety Study Group (NSSG) performed a review of the assembly, transportation, emplacement, and firing phases of the nuclear operations in order to provide assurance that no accidental detonation will occur. The nuclear safety procedures for Project Rio Blanco have been reviewed and approved. In addition to the three above-mentioned review groups which routinely review offsite underground nuclear detonation projects, two other groups were requested by NV to consider Project Rio Blanco. The Manager's Ad Hoc Committee on Rio Blanco conducted an independent review of all aspects of the Rio Blanco project. The Ground Motion and Seismic Evaluation Subcommittee of the Nevada Test Site Planning Board evaluated the seismic instrumentation plan, structural response predictions, and operational requirements for Harvey Gap Dam. (TFD)

21035 (NVO-135) PROJECT DIRECTORS' COMPLETION REPORT D + 30 DAYS (DETONATION RELATED ACTIVITIES). Project Rio Blanco. (Nevada Operations Office (AEC), Las Vegas CER Geonuclear Corp., Las Vegas, Nev.). Jul 1973. 97p. (PNE-RB-48). Dep. NTIS $7.00.

Project Rio Blanco is a government-industry gas reservoir stimulation experiment using three 30-kiloton nuclear explosives detonated simultaneously in a single well bore, at depths of 5840, 6230, and 6690 ft. The detonation occurred at 1000:00.12 hours ± 0.01 second MDT, May 17, 1973, in Rio Blanco County, Colorado.

This report summarizes all available project results as of 2400 hours MDT, June 16, 1973. Evidence to date indicates that there has been no inadvertent release of radiation to the atmosphere, all three explosives detonated and functioned as expected, and no serious architectural or environmental damage occurred. Preliminary seismic estimates indicate that the explosive yields were nominal and the detonation exhibited an equivalent earthquake magnitude of m_b 5.4 (NOAA/National Earthquake Information Center). Rockfalls were not observed beyond approximately 20 miles from the emplacement well. Some minor bioenvironmental effects were evident within a two-mile radius of the emplacement well. Claims for seismic damage in the area have been fewer and less significant than anticipated. (auth)

21036 (PNE-RB-46) PROJECT RIO BLANCO: EVALUATION OF POSSIBLE RADIOACTIVITY TRANSPORT IN GROUNDWATER. Knutson, C. F. (CER Geonuclear Corp., Las Vegas, Nev.). 11 May 1973. 105p. Dep. NTIS $7.25.

The possibility of radioactivity transport in the groundwater system as the result of a hypothetical maximum credible gas leak following the Rio Blanco detonation was evaluated. This evaluation used the specific aquifer characteristics developed from tests in the emplacement well area, instead of the general basinal characteristics used in the initial calculations presented in the Environmental Impact Evaluation. The present study confirms the low radiation levels in the groundwater predicted in the initial calculations. (auth)

21037 (UCID-16302) MEASUREMENTS AND CORRELATION ANALYSIS FOR NUCLEAR CHIMNEY PERMEABILITY. Snoeberger, D. F.; Baker, J.; Morris, C. J. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Jul 1973. Contract W-7405-eng-48. 30p. Dep. NTIS $3.50.

Permeability measurements for large regions at the AEC Nevada Test Site using a nuclear explosion chimney site in alluvium are reported. Atmospheric pressure data at the surface and at 700 ft in the chimney were analyzed by correlation methods, assuming periodic behavior of weather pressure systems. A value of 40 was obtained for the ratio in darcies of permeability to porosity with a one-dimensional model for darcy flow. The porosity is not known independently, but for reasonable values, for example, 0.3, the indicated permeability is of the order of 10 darcies. (auth)

21038 (UCID-16316) PLANT OPERATING SCHEDULE AND PRODUCTION RATE FOR NUCLEAR CHEMICAL MINING OF COPPER. Mallon, R.; Cramer, J. (California Univ., Livermore. Lawrence Livermore Lab.). 24 Jul 1973. Contract W-7405-eng-48. 10p. Dep. NTIS $3.00.

The economic feasibility of in-situ copper mining with nuclear explosives is currently being studied. A proposed plant operating schedule and two case studies of variations in annual copper production are described. For favorable economics, the variation in annual production should be kept to a minimum. There are three principal reasons for variation in output: (1) the necessity to shutdown the plant during the blasting of a new set of chimneys. (2) the below-normal output during reentry of a newly blasted set of chimneys, and (3) the variation of copper production during the life of the chimney. The operating schedule proposed in this note is an attempt to minimize the year-to-year variation in copper production. This schedule is the best of many which were analyzed. Time estimates of each necessary step in establishing a new set of chimneys and placing it in service are included. (auth)

21039 (UCID-16320) TWIG, A COMPUTER CODE FOR THE CALCULATION OF TWO-DIMENSIONAL, IDEAL GAS FLOW IN POROUS MEDIA. Bowman, B. R. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Nov 1972. Contract W-7405-eng-48. 51p. Dep. NTIS $4.75.

Two-dimensional flow of an ideal gas in a porous solid is described from the viewpoint of containing the gas generated in a nuclear device cavity. The flow is assumed to be isothermal and obey Darcy's Law. The governing equations are solved numerically using an explicit finite differencing scheme. From this, the pressure response in the pores and the propagation of the cavity gas is predicted. Features of the solution scheme include treatments of spatial variations in permeability and porosity, and models for the cavity pressure decay. (auth)

21040 (UCRL-51377) PREDICTION OF NUCLEAR EXPLOSION EFFECTS FOR RIO BLANCO. Terhune, R. W. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Apr 1973. Contract W-7405-eng-48. 37p. Dep. NTIS $4.00.

Project Rio Blanco is a proposed joint government-industry natural gas stimulation experiment located 52 miles north of Grand Junction, Colorado. Three 30-kt nuclear explosives are to be emplaced in the same well bore at depths of 5840, 6230, and 6690 ft from the ground surface and detonated simultaneously. The object of the detonations is to develop a large cylindrical permeable fractured region, symmetrical about the well bore, intersecting the multiple interbedded layers of gas-bearing sandstone that exist between the depth interval of 5550 and 6800 ft. When a deeply buried nuclear explosive is detonated, it creates a stress discontinuity (shock wave) of tens of megabars which propagates into the surrounding media. This stress discontinuity deposits energy in the surrounding rock and is thus attenuated as it propagates radially from the source. The energy deposited changes the state of the rock at various distances from the energy source to rock vapor (cavity region), melted rock, fractured rock, and finally at some distance from the source, the wave propagates approximately elastically. Numerical computer programs (SOC and TENSOR) have been developed which are successful in predicting cavity radius, peak shock stess, particle velocity and fracture as a function of distance from the energy source. These programs have, as input data, parameters developed from measurements of rock properties. The results of calculations using the material properties of the rock determined for the Rio Blanco site are presented. Also included are sections on the spall phenomena at the ground surface immediately above the detonation point and a two-dimensional calculation of the fracture pattern where three explosives detonated simultaneously are simulated. (TFD)

21041 (USGS-474-160) SURFACE FRACTURING OF THE CARPETBAG EVENT, YUCCA FLAT, NEVADA TEST SITE, NEVADA. Jenkins, E. C. (Geological Survey, Denver, Colo.). Aug 1973. Contract AT(29-2)-474. 19p. (NTS-233). Dep. NTIS $4.00.

Surface fracturing caused by the Carpetbag Event is linear, bisymmetric, and radiosymmetric. Concentric fractures extend a maximum of 3300 ft from ground zero and average 3175 ft. Major linear fractures 3000 ft west of ground zero indicate the presence of a major buried fault system. (auth)

21042 MILITARY APPLICATIONS OF NUCLEAR TECHNOLOGY. Part 1. Hearing Before the Subcommittee on Military Applications of the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, First Session, April 16, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 57p. GPO $0.50.

The April 16, 1973 hearing before the subcommittee on military applications of the Joint Committee on Atomic Energy is reported verbatim with classified data indicated as deleted. Information is included on the worldwide nuclear arsenal; delivery systems; deployment of stockpiles; nuclear material requirements for military purposes; weapons effects and collateral damage; and the physical security, command, and control of nuclear weapons systems. (LCL)

21043 SURFACE- AND BODY-WAVE SPECTRA OF CANNIKIN AND SHALLOW ALEUTIAN EARTHQUAKES. Hasegawa, H. S. (Dept. of Energy, Mines and Resources, Ottawa). Bull. Seismol. Soc. Amer.; 63: No. 4, 1201-1225(Aug 1973).

Rayleigh waves and P codas of CANNIKIN and shallow Aleutian earthquakes were studied in order to determine the parameters most influential in shaping the respective teleseismic amplitude spectra and in governing the surface (M_S) and body-wave (m_b) magnitudes. For surface-wave generation, the dipole strength (P_o) of the underground nuclear explosion, and the seismic moment (M_o) of the earthquake are the important parameters. The M_S for these events are comparable when M_o is approximately 3 to 4 times greater than P_o. Theoretical considerations of body-wave spectra indicate that the important parameters are the permanent offset in the reduced displacement potential [$\psi(\infty)$] of explosions and the product of area of faulting (S) and average dislocation ($\bar{D}$) of earthquakes. These source parameters are related by $P_o = 4\pi(\lambda + 2\mu) \cdot \psi(\infty)$ and $M_o = \mu \bar{S}D$ where λ and μ are the elastic Lamé parameters. An additional parameter, namely, the peak frequency (f_p) in the explosion P-coda spectrum and the corner frequency (f_c) in the earthquake spectrum, is of paramount importance in determining the respective m_b. For the events considered, f_p is from 5 to 10 times greater than f_c and this is manifest in the corresponding m_b, where the m_b for CANNIKIN is at least a unit greater than that of the earthquakes. The linear dimensions of the respective sources appear to exert a major influence upon f_c and f_p. The large scatter between theoretical and actual m_b values, unfortunately, precludes a firm confirmation of the above theoretical considerations. (auth)

21044 EARTHQUAKE SPECTRUM PREDICTION TECHNIQUE. Johnson, R. A. (Nevada Operations Office (AEC), Las Vegas). Bull. Seismol. Soc. Amer.; 63: No. 4, 1255-1274(Aug 1973).

Empirical equations for the prediction of earthquake psuedo-relative velocity response spectra (PSRV) are determined utilizing 41 spectra calculated from 23 earthquakes at 28 stations. The derived equations employ PSRV attenuation exponents obtained from regression analysis of data acquired in the underground nuclear

explosion program. The resulting relations allow 5% damped PSRV to be predicted for earthquakes, given a magnitude and epicentral distance. The procedure, which is used to predict earthquakes in India, Japan, Colombia and the United States which were not in the data sample, shows good comparison with measured spectra. (auth)

21045 TELESEISMIC P-WAVE TRANSMISSION THROUGH SLABS. Sleep, N. H. (Massachusetts Inst. of Tech., Cambridge). Bull. Seismol. Soc. Amer.; 63: No. 4, 1349-1373(Aug 1973).

Theoretical ray paths through velocity models constructed from numerically calculated thermal models of slabs were computed. The results were in good agreement with observed travel times. First motion amplitudes of P waves at teleseismic distances were measured from long- and short-period WWSSN records of intermediate focus earthquakes in the Tonga, Kermadec, and Kurile regions and of nuclear explosions and shallow earthquakes in the Aleutian region. These amplitudes were corrected for source mechanism. The Aleutian data were sufficient to show that intermediate focus earthquakes in that region occur in the colder regions of the slab. At short periods, for regions other than the Aleutians, shadowing effects which could be associated with the slab were not very marked, less than a factor of 2 reduction for epicentral distances between 30° and 50°. No systematic effects due to plates were found in the long-period data. Some stations in the predicted shadow zone of a Tonga earthquake recorded low amplitude precursors which probably were greatly defocused waves which ran the full length of the slab. Simple diffraction is incapable of explaining the short-period results. (auth)

21046 NUMERICAL STUDY OF TECTONIC STRESS RELEASE BY UNDERGROUND EXPLOSIONS. Andrews, D. J. (Massachusetts Inst. of Tech., Cambridge). Bull. Seismol. Soc. Amer.; 63: No. 4, 1375-1391(Aug 1973).

Fault dislocation driven by the hoop stress associated with the P wave from an underground explosion is proposed as a mechanism for tectonic stress release. The mechanism is examined in two-dimensional numerical simulations. Determined initial value problems can be posed, from which plots of near-field motion are obtained. If tectonic stress is near the limit allowed by friction, then sliding can explain observed SH amplitudes. The source-time functions of both the explosion and the dislocation are equivalent to step functions at long periods. The corner period for the dislocation is less than 1 sec for low-yield explosions with relative double-couple strengths less than 1.0. (auth)

21047 METHOD FOR RELOCATING SEISMIC EVENTS USING SURFACE WAVES. Crough, S. T.; Van der Voo, R. (Univ. of Michigan, Ann Arbor). Bull. Seismol. Soc. Amer.; 63: No. 4, 1305-1313(Aug 1973).

Seismic events can be relocated relative to a reference event by using the group-velocity dispersion curves of surface waves. Since group velocity is a function of the travel path, surface waves from two events in the same locale should show identical group velocities when viewed at any one seismograph station. A computer technique was developed for comparing the group-velocity curves of any event with the curves of a reference event and for determining the relocation which causes the curves to best coincide. The method is evaluated by relocating eight intermediate-size nuclear explosions of the Nevada Test Site series. With precise curve fitting, the surface-wave locations are slightly more accurate in southern Nevada than the standard body-wave determinations. The surface-wave origin times are considerably more accurate. In areas of sparse station coverage or of many small earthquakes, the surface-wave method can be expected to improve seismic locations significantly. (auth)

21048 NUCLEAR-EXPLOSION PETROLEUM-STIMULATION PROJECTS: UNITED STATES AND USSR. Terman, M. J. (Geological Survey, Washington, DC). Amer. Ass. Petrol. Geol. Bull.; 57: No. 6, 990-1026(Jun 1973).

Both the United States and the USSR have conducted experimental programs in the application of underground nuclear explosions to peaceful uses, particularly as related to the petroleum industry. Both nations recognize that the explosive creation of an extensive pattern of fractures in a reservoir will increase current production and ultimate recovery percentages. Both nations also appear fully aware of and able to control radiologic and seismic hazards. However, in the United States at least, the cost of the nuclear device deters wider use. A comparative review of the published data from both countries on the geologic environments chosen for these nuclear-explosion programs clearly indicates significant differences in approach and objectives. The two American projects, Gasbuggy and Rulison, involve the detonation of single devices at moderate depth within expansion-drive natural gas reservoirs consisting of stratigraphic traps in thick, low-permeability clastic rocks of Cretaceous age; the resultant stimulation hopefully will raise submarginal deposits to commercial levels. The USSR projects involve the detonation of multiple nuclear devices at moderate depths within or below depletion- or water-drive oil or gas reservoirs consisting of structural or stratigraphic traps in thick, moderately permeable carbonates of late Paleozoic age; the resultant intensification hopefully will increase production and ultimate recovery and thus decrease exploitation costs in currently commercial deposits. (auth)

Protective Structures and Equipment

21049 (LA-5349-PR) PERFORMANCE OF MULTIPLE HEPA FILTERS AGAINST PLUTONIUM AEROSOLS, JANUARY 1–JUNE 30, 1973. Ettinger, H. J.; Elder, J. C.; Gonzales, M. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

Field sampling has provided general criteria defining plutonium aerosol size characteristics and activity concentrations from typical plutonium operations. Two fabrication facilities have aerosols with activity median aerodynamic diameter's (amad) ranging from 2 to 5 μm; the two research and development facilities indicate amad's ranging from 1 to 4 μm; and a recovery facility consistently shows a sub-micron aerosol with a typical amad of 0.3 μm. This recovery facility also produces aerosols as small as 0.1 μm amad, has the highest activity concentration, and constitutes the most difficult air cleaning problem. Using laboratory produced plutonium test aerosols with size characteristics similar to those defined by the field sampling program, multiple HEPA filter systems were evaluated to provide quantitative data defining performance of successive stages of HEPA filters, and filter performance as a function of particle size. Test data show that the first and second HEPA filter each provide overall efficiencies in excess of 99.99%, while the third HEPA filter provides an average efficiency in excess of 99.8%. These performance levels exceed AEC requirements. Data defining performance of the first and second HEPA filters as a function of plutonium aerosol size show that HEPA filter efficiencies are in excess of 99.99% for sub-micron plutonium aerosols. Theoretical calculations estimating alpha radiation dose to the filter fibers from particles collected on the fibers indicate a dose on the order of 10^6 rads per minute. (auth)

21050 SUIT HEATER. Grega, M. G.; Shivers, R. W.; Beckman, E. L. (to United States Atomic Energy Commission). Australian Patent 415,410. 19 Jul 1971. Priority date 27 Jun 1967, United States of America (USA).

A suit heater is described in which the heating is accomplished by flowing a heated fluid through a passageway in the garment. The fluid is heated by a radioisotope heat source. (RCK)

21051 ATOMIC SAFETY. McLean, A.; Clarke, A. C. W. V. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Occup. Health (London); 25: No. 5, 171-175(May 1973).

Industrial safety within the atomic industry is briefly discussed in very broad terms, with particular reference to the U.K.A.E.A. The interpretation of ICRP and ILO recommendations is mentioned, the former being interpreted in the U.K. by the M.R.C. Handling, workers clothing, measurement, and the importance of recording the radiation history of each worker are also mentioned. The preliminary results of a study of the health record of workers in the A.E.A. contain nothing to suggest that these workers have an abnormal incidence of disease, especially of those diseases which might be attributable to radiation. (UK)

Safety Engineering

Refer also to abstract 23663.

21052 (ORNL-TM-4299) ELECTRICAL SAFETY: GROUND FAULT INTERRUPTERS. Murphy, C. E. (Oak Ridge National Lab., Tenn.). 27 Aug 1973. 7p. Dep. NTIS $3.00.

Current leaking to ground on the load side of a protected circuit causes an imbalance in the circuit. This produces a change in flux in the magnet core, inducing voltage in the transformer's secondary winding which causes the solid state circuitry to open the circuit before the individual is hurt who is in the "ground leak circuit." The equipment, cost, and a demonstration panel on the use and need for ground fault interrupters are described. This type protection is mandatory for outside electrical inlets in residential construction and the National Electric Code has been interpreted to require it in ORNL facilities where applicable. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 20759 and 21124.

21053 SOLUBILIZATION OF URANIUM IN ROCKS BY BACTERIA NOT BELONGING TO THE THIOBACILLUS CLASS. Magne, R. (Ecole Nationale Superieure de Geologie Appliquee et de Prospection Miniere, Nancy). Compt. Rend., Ser. D; 276: No. 19, 2625-2628(9 May 1973). (In French).

Bacteria not belonging to the Thiobacillus class can actively solubilize uranium in granitic rocks. This solubilization occurs only in the presence of a suitable organic substrate in the medium. When this condition is fulfilled, the microbe solubilization can still be further stimulated by the addition of thymol, this compound intervening by increasing the production of active complexing compounds such as oxalic acid. (FR)

21054 GENESIS OF THE AUREOLES OF RADIOGENIC LEAD FROM PRECAMBRIAN URANIUM DEPOSITS. Tarkhanov, A. V.; Zhukova, V. I. At. Energ. (USSR); 34: No. 6, 455-460(Jun 1973). (In Russian).

Areas considered are the correlations between lead and uranium concentrations in uranium minerals, ores and wallrock, the form in which radiogenic lead occurs, the genesis of its aureoles and possibilities of using lead isotopes in prospecting for mineral deposits and evaluation of radioactive anomalies. Uranium minerals of precambrian metasomatic deposits lost more than a quarter of their radiogenic lead, while in the remaining part a considerable amount is bound in galenas and more than half enters the crystal structure of pitchblendes and uraninites. There are aureoles of radiogenic lead in wallrocks around the ore bodies. The ratio $^{207}Pb/^{206}Pb$ in wallrocks and galenas ranges between 0.122 and 0.129. The formation of these aureoles is associated with the removal of radiogenic lead from the 1800 million-year old uranium ores 400 to 600 million years ago. The precambrian uranium deposits are the most favorable for the application of the lead-isotope method of prospecting for uranium deposits of this type. (auth)

21055 DISTRIBUTION OF URANIUM IN CARBONACEOUS ROCKS. First Results on the Mesozoic Campano. Dall'aglio, M. (CNEN, Casaccia, Italy); D'Argenio, B. Boll. Soc. Natur. Napoli; 80: 129-137(1971). (In Italian).

Some 50 samples of carbonate rocks of lower Liassic and Cretaceous age collected in the Campanian Apennines were analyzed. The analyses show a variable distribution of uranium content (from less than 1 to about 5 ppM), although the average values are higher than the standard ones currently quoted. Problems related with the above variations are presented and discussed. (auth)

21056 PREHISTORIC ATOMIC PILE. Vendryes, G. (CEA, Paris). Umsch. Wiss. Tech.; 73: No. 10, 292(1973). (In German).

Natural uranium contains 0.72% of the isotope ^{235}U. In the uranium deposit in Oklo, Gabon, the concentration amounts to 0.44% only. This is the consequence of a prehistoric chain reaction 1.7 billion years ago. Five preconditions for this phenomenon are given. (auth)

Radioactive Effluents

Refer also to abstracts 20758, 20861, 21074, 21677, 21680, 21683, 21763, and 23592–23594.

21057 (AECL-4501) HOURLY AVERAGE CONCENTRATIONS OF POLLUTANTS DUE TO POINT EMISSIONS NEAR TO THE GROUND: A PROBABILISTIC APPROACH. Le Quinio, R. (Commissariat a l'Energie Atomique, Paris (France)). Mar 1973. Translation of IAEA Paper SM-169/14. (CONF-730217-2). 8p. Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on the principles and standards of reactor safety; Julich, F. R. Germany (5 Feb 1973).

Several hundred atmospheric diffusion experiments using uranine yellow or sodium fluorescein as tracers were carried out during the past ten years at ten or so sites in France. For sources close to the ground (0 to 50 m) the values of the maximum concentrations at 2.5 km and 11 km have log-normal distributions with essentially the same standard deviations. The probability that predetermined concentrations will be exceeded is deduced directly from these laws and not by means of approximately representative calculations. (auth)

21058 (BNWL-1732) SOME EXPERIMENTAL MEASUREMENTS OF AIRBORNE URANIUM (REPRESENTING PLUTONIUM) IN TRANSPORTATION ACCIDENTS. Mishima, J.; Schwendiman, L. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Aug. 1973. Contract AT(45-1)-1830. 76p. Dep. NTIS $5.45.

Experiments were performed to measure the fractional release of uranium compounds when these materials are involved in gasoline fires. Uranium was used as a reasonable stand-in for plutonium. In the experiments reported uranium dioxide particles or uranium nitrate in solution was deposited on various materials ranging from a smooth metal surface to soil. Gasoline was added to these materials, then ignited. Airborne particles were collected at points downstream in the duct in which the combustion tray was located. Various air flow and burning conditions were used. In the burning experiments in which a uranyl nitrate solution was deposited on a stainless steel plate, 11% was made airborne with an air flow of 23 mph. This release was the largest for the burning experiments; however, as much as 24% of uranium dioxide powder was aerodynamically entrained from dry, sandy soil by air at a velocity of 20 mph. No single variable of the conditions imposed in 40 experiments could be identified as having an over-riding influence on the releases of uranium within the range of variables included in these experiments. A gasoline fire, in which 500 gallons were dumped and burned, affirmed that the smaller scaled experiments were reasonably representative of actual fires. (auth)

21059 LOW-LEVEL RADIATION. Sternglass, E. J. New York; Ballantine Books (1972). 223p. $1.25.

21060 SPILL PREVENTION, CONTAINMENT, AND COUNTERMEASURE (SPCC) PLAN OF THE REFUSE ACT PERMIT PROGRAM. Cox, J. B. (Environmental Protection Agency, Washington, DC). pp 27-34 of Control of Hazardous Materials Spills. Washington, DC; Graphics Management Corp. (1972).

From national conference on control of hazardous material spills; Houston, Texas, USA (21 Mar 1972). See CONF-720354-.

Guidelines for the spill prevention, containment, and countermeasure plan of the Refuse Act Permit Program are given. These guidelines apply to the discharge of all toxic materials including radioactive discharges. The basic objective of the plan is to protect the waterways from spills. (ERB)

21061 REFERENCE LEVELS IN HEALTH PHYSICS. Fieuw, G.; Bultynck, H. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp A.3.1-A.3.7 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

In order to conduct a safe operation of the Nuclear Research Centre, precautionary measures are taken beforehand in order to reduce all releases to a strict minimum. All releases through stacks, taking into account the nature of the radioactive release (total α and $\beta-\gamma$, ^{131}I, HTO, radon, and gases), are monitored before going into the atmosphere. Continuous monitoring of the activity attached to suspended particles in the air and of the ambient exposure in the immediate surroundings is carried out by six fixed monitoring stations. The integrated dose over 50 yrs due to an internal and/or an external radiation of a reference organ of an individual, continuously exposed during 13 weeks to the consequences of a release into the atmosphere may not exceed $\frac{1}{40}$h of the yearly permissible dose to the same reference organ of a radiation worker. The consequence of a release may consist in an immediate external radiation by the plume leaving the stack or in an internal radiation due to inhalation or to the intake of any contaminated food or water coming from an area contaminated by the release into the atmosphere. The radioactive liquid waste coming from CEN/SCK is released after treatment into the MOL NEET, an affluent of the GROTE NEET. Monitoring is performed before releasing in order to check if the activity levels remain below the maximum permissible levels imposed by Public Authority. If levels are too high, further treatment has to be provided before the liquid waste will be released into the open. Complementary check points are foreseen at different locations of the NEET basin. (auth)

21062 SOME ASPECTS OF MONITORING AS PRACTICED AT RCN. Stoute, J. R. D. (Reactor Centrium Netherlands., Petten). pp B.1.1-B.1.4 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The question of to what extent the monitoring practiced at R. C. N. can be regarded as suitable in connection with the maximum acceptable levels of radiation and contamination is considered. Some special instruments for the measurement of surface and air contamination are reviewed. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 20872, 20875, 21036, 21147, 21654, and 21680.

21063 (ARMS-72.6.1) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE LAKE ONTARIO ORDNANCE WORKS AND VICINITY IN JUNE 1972. (EG and G, Inc., Las Vegas, Nev.). Aug 1973. 24p. (EGG-1183-1554). Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the Lake Ontario Ordnance Works and surrounding area of New York State on 17 June 1972. The site was used for the storage of certain materials related to the processing of uranium. The survey was part of a cleanup program at the site. The data included a survey of the terrestrial background gamma radiation and an analysis of selected soil samples. A high-sensitivity detection system collected gamma spectral and gross-count data. The data were then computer processed into an isoexposure contour map, 3 feet above the ground, of a 21-square-mile area. Results indicated the presence of two storage areas with a high concentration of ^{226}Ra and its daughters. In addition, an independent ground survey was conducted by the United States Atomic Energy Commission, Oak Ridge Operations Office (USAEC/ORO), during June 1972, following cleanup operations. These results are compared with the ARMS measurements. Results from both surveys confirm that, with the exception of Six Mile Creek and areas adjacent to the storage sites, the measured levels in the uncontrolled areas surrounding the site did not exceed 50 μR/hr. (auth)

21064 (BNWL-1723) ENVIRONMENTAL SURVEILLANCE FOR FUEL FABRICATION PLANTS. Corley, J. P.; Waite, D. A.; Johnston, J. W.; Schwendiman, L. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1973. Contract AT(45-1)-1830. 71p. Dep. NTIS $5.45.

A report is presented that is intended to provide source material, with rationale, which may be used for: (a) Preparation of a regulatory guide concerning environmental surveillance programs for such facilities; (b) Evaluation of those portions of environmental statements for fuel fabrication facilities pertaining to proposed environmental surveillance programs. Included is an environmental surveillance program sufficiently general to cover plants fabricating uranium oxide or mixed uranium and plutonium fuels. (auth)

21065 (BNWL-1751(Pt.1)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1972 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Volume II. Physical Sciences. Part 1. Atmospheric Sciences. Simpson, C. L. (Battelle Pacific Northwest Labs., Richland Wash.). Apr 1973. Contract AT(45-1)-1830. 162p. Dep. NTIS $7.60.

A separate abstract was prepared for each section of the report. (DHM)

For abstracts of individual sections see: 20667, 20716, 21066, 21078–21097, 21148, 21167–21178, 21398, 21399, and 23911–23914.

21066 (BNWL-1751(Pt.1), pp 114-116) RADIOACTIVE FALLOUT RATES AND MECHANISMS: BEHAVIOR AND CHARACTERISTICS OF RADIOACTIVE DEBRIS FROM CHINESE NUCLEAR WEAPONS TESTS. Thomas, C. W.; Silker, W. B.; Jenkins, C. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The concentrations of trace elements, cosmogenic radionuclides, and nuclear-weapons-produced radionuclides were measured in air, precipitation, and seawater to study the rates of atmospheric and oceanic mixing, the rates of air-sea interchange, and the rates and mechanisms of precipitation scavenging. Radioactive debris from the Chinese nuclear test on March 18, 1972 was measured in air and in grass samples collected on two arcs from San Francisco to Seattle and from Texas to Chicago to determine the path of the debris, the rate of deposition on the earth's surface, and the ^{131}I content of milk samples, and the dose to man. The concentrations of plutonium isotopes resulting from nuclear tests and from SNAP-9A nuclear generator burnup were measured in air samples collected from 1963 to 1972 at Richland, Washington. (auth)

21067 (NVO-269-19) AMCHITKA RADIOBIOLOGICAL PROGRAM. Progress Report, March–December 1972. Held, E. E.; Nelson, V. A.; Schell, W. R.; Seymour, A. H. (Washington Univ., Seattle. Lab. of Radiation Ecology). Jun 1973. Contract AT(26-1)-269. 97p. Dep. NTIS $7.00.

Recent results of analyses were appended to previously prepared tables and include analyses for: gamma-emitting radionuclides in air filters, seawater, fresh water, marine algae, marine invertebrates, marine fish, sea otter, and freshwater aufwuchs, moss, plants, and fish; strontium-90 (^{90}Sr) in rats and birds; and tritium (^{3}H) in seawater, fresh water, and fish. Tables from the previous reports were revised by summarizing the pre-Cannikin data, recalculating the values for zirconium-95 (^{95}Zr) and niobium-95 (^{95}Nb), and adding data for beryllium-7 (^{7}Be). Also, the limits of ^{3}H detection were lowered to about 15 tritium units (TU). The results of the recent analyses indicate that: no new radionuclides are present; the most abundant radionuclides are naturally occurring ^{7}Be and potassium-40 (^{40}K); the trace quantities of fission products, induced radionuclides and ^{3}H present are from world fallout; and, a trace of ^{3}H contamination remains in some Long Shot ponds as previously reported. It is concluded from the results of analyses of samples collected between September 1969 and December 1972 as reported in this and two previous progress reports, that there were no radionuclides of Milrow or Cannikin origin in the water, plants, and animals of Amchitka Island. (auth)

21068 (ORNL-EIS-73-21(Suppl.1)) ENVIRONMENTAL ASPECTS OF PLUTONIUM AND OTHER ELEMENTS: A SELECTED, ANNOTATED BIBLIOGRAPHY. (Oak Ridge National Lab., Tenn.). Aug 1973. 479p. Dep. NTIS $26.00.

This supplement to the bibliography (ORNL-EIS-72-21) contains an additional 884 references that have been prepared for computer storage and retrieval. The literature was selected to meet the needs of the Nevada Operations Office, Las Vegas, Nevada, but should be of interest to others in related fields. The deposition and movement of plutonium, americium, and uranium and their pathway through terrestrial and aquatic ecosystems to man are emphasized. An effort is made to include numerical data in the abstracts. (CH)

21069 (PNE-WW-30) ENVIRONMENTAL MONITORING REPORT PERIOD COVERING FEBRUARY 1, 1973–April 30, 1973. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 1973. 24p. Dep. NTIS $3.25.

For El Paso Natural Gas, Co., TX.

Data are reported on the β radioactivity in environmental samples collected during February through April 1973 in the vicinity of the underground nuclear explosion for the stimulation of natural gas production at Pinedale, Wyoming. Data are included on the radioactivity in samples of surface waters, drinking waters, and air particulates, and on the content of tritium in water and of ^{90}Sr in vegetation. (CH)

21070 (STI/DOC-10/148) CONTROL OF IODINE IN THE NUCLEAR INDUSTRY. Technical Reports Series No. 148. Report of a Panel on the Control of Iodine and Other Constituents of Airborne Radioactive Wastes Held in Vienna, October 19–23, 1970. (International Atomic Energy Agency, Vienna (Austria)). Jun 1973. 106p. (In English and Russian). (Conf-701077–). IAEA $4.00.

A separate abstract was prepared for the report of the panel and a separate abstract was prepared for each of the seven papers presented. (DHM)

For abstracts of individual papers see: 20733, 20872–20875, 21074, 23459, and 23542.

21071 (UCRL-51412) FIELD SPECTROMETRIC MEASUREMENTS OF RADIONUCLIDE CONCENTRATIONS AND EXTERNAL GAMMA EXPOSURE RATES AT THE NEVADA TEST SITE. A Demonstration Study. Anspaugh, L. R.; Phelps, P. L.; Huckabay, G. W.; Todachine, T. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Jul 1973. Contract W-7405-Eng-48. 19p. Dep. NTIS $4.00.

A two-day study was conducted at the Nevada Test Site to demonstrate the feasibility of using a portable Ge(Li) detector system to conduct a large-scale survey of the gamma-emitting radionuclides present in the environment. The technique of using field spectrometry to quantitate radionuclide concentrations and external gamma exposure rates is briefly summarized. Measurements were made at 14 locations close to the Baneberry and Sedan fallout fields. Fifteen radionuclides were identified and quantitated, including twelve fallout radionuclides: ^{54}Mn, ^{60}Co, ^{106}Ru, ^{103}Rh, ^{103m}Rh, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{155}Eu, and ^{174}Lu. Most were associated with the Sedan fallout field, but Baneberry contributed significantly to the present levels of ^{54}Mn,

^{60}Co, ^{106}Ru, ^{125}Sb, and ^{134}Cs. ^{137}Cs was the most abundant radionuclide at 10 of the 14 locations and varied from 438 to 9960 nCi/m^2. The most abundant radionuclide at any location was ^{102m}Rh, which had a maximum level of 19,160 nCi/m^2. External gamma exposure rates varied from 16.4 to 406 $\mu R/hr$; the latter is equivalent to 3.1 rad/yr and is mostly due to the presence of ^{60}Co and ^{102m}Rh. The levels of naturally occurring radionuclides varied by as much as a factor of 2. The field spectrometry method is compared with other methods of conducting a large-scale survey. It is much faster than soil sampling followed by laboratory analysis and produces much more detailed data than airborne detector systems. The primary disadvantage is that for accurate results for the concentration of fallout radionuclides, a few well-chosen soil samples are necessary to define distribution with depth in the soil. Accurate results for external gamma exposure rates partitioned according to individual radionuclides can be obtained without additional data on depth distributions. (auth)

21072 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 6, 387-395(Jun 1973).

Data are presented on levels of radioactivity in environmental samples collected in the vicinity of Knolls Atomic Power Laboratory during 1971. (CH)

21073 CONTROL OF HAZARDOUS MATERIAL SPILLS. Proceedings of the 1972 National Conference, Houston, Texas, March 21–23, 1972. Washington, DC; Graphics Management Corporation (1972). 230p. (CONF-720354–).

A separate abstract was prepared for one of the 37 papers presented in this conference. The other papers discuss: protection of the environment from hazardous material spills; prevention of hazardous material spills in heavy process industry; contingency planning for response to hazardous material spills; containment of spilled hazardous materials; detection and identification of hazardous material spills; treatment systems for waters contaminated by hazardous materials; effects of hazardous material spills on the environment; and ecology restoration of waterways following hazardous material spills. (ERB)

For abstract of an individual paper see: 21060.

21074 REPORT OF THE PANEL. pp 3-26 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

A panel of experts from seven states and two international organizations was convened at IAEA headquarters in Vienna, Austria on October 19 to 23, 1970 to review the status of monitoring, analysis, and control of iodine emission from nuclear plants. The report of this panel is presented which includes consideration of the following topics: radiological aspects of radioiodine discharges to atmosphere, iodine chemistry related to removal and monitoring processes, systems for iodine removal and monitoring, monitoring devices, behavior of iodine in reactor systems, and control of iodine emissions from reprocessing plants. (DHM)

21075 AIR MONITORING IN PLUTONIUM LABORATORIES. Binard, L. (Centre d'Etude de l'Energie Nucleaire, Mol, Bel.). pp B.7.1-B.7.3 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The air surveillance of the laboratories of the CEN/SCK-BELGONUCLEAIRE group is performed through the use of the following apparatus: equipment making continuous measurements and giving an alarm signal in case of a contamination; and instruments making postponed measurements of the activity of deposits obtained from air filters, samples being taken at several places in the laboratories. The instrumentation that has thus been established, meets two goals: to warn rapidly the personnel working in these laboratories; to allow the reconstruction of the incident and the judgment of its importance, following the accurate measurement of the contamination of the air at different places. The realization of this apparatus has given rise to two major problems. They were caused by the very low dose allowed for Pu (2.10^{-12} Ci/m^3) and the presence of natural radioisotopes in a radioactive concentration much higher than the former (up to several times 10^{-10} Ci/m^3). The very low permissible dose makes it necessary to mechanically concentrate the available contamination. This is achieved by the passage of the air through fixed filters. As a result of this, the instruments measure an integrated dose. (BE)

21076 METHOD OF AGE ESTIMATION OF RADIOACTIVE FALLOUT BY MEASURING THE ACTIVITY OF ^{95}Nb. Tatewaki, T. (Shinshu Univ., Nagano, Japan). Radioisotopes (Tokyo); 22: No. 5, 227-233(May 1973).

A new method is described for estimating the age of a given radioactive fallout by a Ge(Li) γ-ray detector with high resolution. The age is calculated by this method from the two measured values of the activity of ^{95}Nb at a given time interval in the hot particles due to the 7th Chinese nuclear test explosion carried out on December 24, 1967. The results are in fairly good agreement with the actual values of the ages, and also with the estimated ones by the activity ratios of ^{95}Zr to ^{95}Nb. The expected errors for the results and the necessary measurement accuracies for the number of the atoms of ^{95}Nb and the time intervals to estimate the age within the errors 1 to 2 days, are given in the tables. (auth)

21077 ENVIRONMENTAL RADIOACTIVITY IN NORTH TAIWAN. Weng, P. S.; Chu, T. C.; Tsai, C. M. (National Tsing Hua Univ., Hsinchu, Taiwan). Health Phys.; 25: No. 2, 123-128 (Aug 1973).

The environmental survey data during 1960 through 1971 in the Hsinchu area where the 1-MW Tsing Hua Open-pool Reactor is located are presented. Relatively high activity from nuclear weapon tests at Lop Nor off mainland China since 1964 is indicated with corresponding dates and sequence number of the tests, while before 1964 the high activity was due to nuclear weapon tests in Siberia. Total beta activity was measured for most of the environmental samples except the vegetations and agricultural products of which the naturally occurring activity due to ^{40}K was also determined. (auth)

Atmosphere

Refer also to abstracts 21058, 21398, 21399, 23910, 23913, 23914, and 24002.

21078 (BNWL-1751(Pt.1), pp 1-5) INFLUENCE OF SOIL RESUSPENSION ON THE AIRBORNE PARTICLE SIZE DISTRIBUTION. Sehmel, G. A.; Lloyd, F. D, Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The airborne particle size distribution function of resuspended soil was determined as a function of particle diameters from 1 to 230 μm and sampling heights from 0.3 to 30 m. An apparent lower limit was determined for the size distribution function. Soil resuspension can cause relatively high soil injection rates into the atmosphere, which increase the magnitude of the size distribution function above this lower limit. The soil resuspension rates are a direct function of the hours of high wind speed occurring during dusty time periods. However, the resuspension rates must also be a function of the persistence of these high winds since less resuspension occurred for the same total hours of high winds when these hours were accumulated over a longer time period. (auth)

21079 (BNWL-1751(Pt.1), pp 5-15) INITIAL RESUSPENSION MODELS FOR AEROSOL PARTICLES FROM EARTH'S SURFACE. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Studies on the resuspension of aerosol particles from the earth's surface are reported. For $u_* \gtrsim 20$ cm sec^{-1}, horizontal wind fluctuations can dislodge most sub-millimeter particles from dry soil. This suggests that the soil particle size distribution is the controlling factor of the airborne particle size distribution in the near-surface layer. Above the surface layer, it is shown that the convective diffusion equation is incapable of explaining experimental data. A statistical approach based on the probability distribution of vertical wind speeds is explored and it is shown that observed wind speed data does correctly describe the size distribution of large, resuspended particles. (auth)

21080 (BNWL-1751(Pt.1), pp 15-22) Pu RESUSPENSION BY WIND AT ROCKY FLATS. Sehmel, G. A.; Orgill, M. M. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Airborne plutonium concentrations are being related to meteorological parameters at Rocky Flats in anticipation that these data will increase understanding of environmental resuspension processes. Airborne concentrations at sampling station S-8 were related to wind speed for one time period from July 1970 to January 1971. (auth)

21081 (BNWL-1751(Pt.1), pp 26-27) FRACTIONAL AIRBORNE RELEASE OR RADIOACTIVITY DURING THE BURNING OF CONTAMINATED SOLVENTS. Mishima, J.; Schwendiman, L. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Laboratory scale experiments were conducted to indicate the airborne release of radioactive materials in the event of a fire involving flammable solvents used in the separation of nuclear materials. The fractional release of materials during the burning of 30 percent normal tributyl phosphate in a kerosine diluent was being measured. The solvent contains realistic amounts of materials representative of those found in contaminated process solvents (uranium, cesium, cerium, zirconium, iodine, and ruthenium). Trace quantities of active isotopes were used to follow the distribution of the materials except in the case of uranium. Release measured thus far under nominal conditions (distillation of the diluent) have been under 1 percent. (auth)

21082 (BNWL-1751(Pt.1), pp 28-33) AIRBORNE RELEASE OF PLUTONIUM AND ITS COMPOUNDS DURING OVERHEATING INCIDENTS. Mishima, J.; Schwendiman, L. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A study has been in existence for some time to evaluate the amount and distribution in aerodynamic size fractions of plutonium airborne under some conditions found in postulated accidents. Data are presented from forty experiments performed in the wind tunnel in the Radioactive Aerosol Release Test Facility to measure releases under various combinations of parameters involving uranium (a plutonium simulant) forms, surfaces, wind speed, and the presence or absence of a gasoline fire. The second study involves airborne release during the burning of contaminated waste in the Radioactive Aerosol Release Tank. (auth)

21083 (BNWL-1751(Pt.1), pp 34-43) PROFILE-DERIVED ESTIMATION OF CROSSWIND INTEGRATED EXPOSURE FROM ELEVATED SOURCES: MODEL REVISIONS AND APPLICATIONS. Elderkin, C. E.; Powell, D. C. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The prediction of ground level exposure to a depositing tracer released from an elevated source is shown to be highly sensitive to changes in the surface roughness parameter, z_0. At close downstream distances the order of magnitude differences in predicted exposure are due to differences in σ_z associated with the differences in z_0. At downstream distances on the order of 5 to 15 kilometers, the predicted exposure differences are due primarily to different deposition effects associated with differences in z_0. The same analysis for a nondepositing tracer shows slight differences in predicted exposure at the greater downstream distances associated with changes in z_0. However, the predicted exposures at these distances for the nondepositing tracer are of a higher order of magnitude than those for the depositing tracer. (auth)

21084 (BNWL-1751(Pt.1), pp 43-49) DRY DEPOSITION PROCESSES. Sehmel, G. A.; Sutter, S. L.; Dana, M. T. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A predictive model for deposition velocities was developed to describe isothermal particle deposition to flat surfaces when gravity is assisting, opposing, or not influencing deposition. In order to determine the effect of surface roughness on deposition, experimental deposition velocities were determined over gravel surfaces. Comparisons in deposition velocities are made for the flat surface, the gravel surface, and an artificial grass surface. For the grass surface, the results of a field experiment showed that deposition velocities obtained in the laboratory can be applied to similar surfaces in the open atmosphere. (auth)

21085 (BNWL-1751(Pt.1), pp 50-52) ^{85}Kr TRACER FIELD EXPERIMENTS ON THE HANFORD DIFFUSION GRID DURING 1972. Nickola, P. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research, Vol. II, Pt. 1.

Five successful major field experiments were carried out on the Hanford field diffusion grid during calendar year 1972. Considerable effort was expended in reconfiguring portions of the grid for compatibility with objectives of the experiments. Assay and analysis of field samples and data from four of the five tests are not complete. (auth)

21086 (BNWL-1751(Pt.1), pp 52-57) COMPARISON OF MEASURED EXPOSURES WITH EXPOSURES COMPUTED FROM MEASURED AND FROM PASQUILL'S σ_y AND σ_z VALUES. Nickola, P. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Plume dimensions and exposures (time integrated concentrations) observed during an example field test using ^{85}Kr and rhodomine as tracers are presented. The observed dimensions and exposures are compared to exposures computed by means of a commonly used Gaussian plume model. The σ_y and σ_z values used in the model are those prescribed by the Pasquill curves, and those actually observed during the field test. The observed and computed exposures are at considerable variance in all cases. The discrepancies are partially due to lack of consideration of deposition in this Gaussian model. (auth)

21087 (BNWL-1751(Pt.1), pp 58-59) APPLICATION OF THE ^{85}Kr MONITORING SYSTEM TO METEOROLOGICAL DIFFUSION-DEPOSITION EXPERIMENTS. Ludwick, J. D.; Nickola, P. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The ^{85}Kr field tracer system has been modified by the incorporation of additional field sensors, by the addition of improved techniques and instrumentation for tracer storage and dispersal, and by the incorporation of recording procedures which permit rapid computerized data processing. To date, the improved tracer system has been employed during four field particle diffusion-deposition experiments. (auth)

21088 (BNWL-1751(Pt.1), pp 79-82) AIRBORNE MEASUREMENTS OF THE SIZE DISTRIBUTION OF AgI PARTICLES. Alkezweeny, A. J.; Radke, L. F. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Airborne measurements were made to determine the size of AgI particles produced by flares and acetone generators. It was found that flare particles are good cloud condensation nuclei and many particles are larger than 0.1 μm. Particles produced by acetone generator are predominantly below 0.1 μm in diameter. (auth)

21089 (BNWL-1751(Pt.1), pp 83-85) POSSIBLE CHANGES IN AEROSOL PARTICLE DISTRIBUTIONS CAUSED BY IN-CLOUD SCAVENGING. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Predictions are made about the evolution of the aerosol particle number and volume distributions caused by interaction with simple nonprecipitating, warm clouds. The rate of decrease of the Aitken nuclei concentration is shown, as is the influence of trace gas conversion on the size distribution of those particles which are active as cloud condensation nuclei. (auth)

21090 (BNWL-1751(Pt.1), pp 88-90) TRACER STUDIES IN THE NATIONAL HAIL RESEARCH EXPERIMENT. Young, J. A.; Thomas, C. W.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The National Hail Research Experiment (NHRE) is being conducted during summer seasons in northeastern Colorado. The main objective of NHRE is to determine the feasibility of preventing damaging hail by seeding with silver iodide, to determine precipitation scavenging efficiencies, aerosol and hydrometeor trajectories, and ice nucleation mechanisms using natural and artificial tracers. During 1972 six inert tracers were released sequentially into the updrafts of convective storms from just below cloud base on July 24 and 26. Samples of rain and hail from these storms, collected using 250 rain-hail separators, are now being analyzed by neutron activation for the tracers, silver iodide, and other elements to determine scavenging efficiencies and trajectories. Measurements of the concentrations of the cosmogenic radionuclides ^{38}Cl($t_{\frac{1}{2}}$ = 37 min) and ^{39}Cl($t_{\frac{1}{2}}$ = 55 min) in precipitation from several convective storms were used to calculate the elapsed time between the beginning of coalescence and the arrival of the precipitation at the ground. (auth)

21091 (BNWL-1751(Pt.1), pp 90-92) USE OF NATURAL AND MAN-MADE RADIONUCLIDES TO STUDY IN-CLOUD SCAVENGING PROCESSES. Young, J. A.; Thomas, C. W.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The concentrations of cosmic-ray-produced radionuclides, nuclear-weapons-produced radionuclides, and radon daughters were measured simultaneously in rain and in ground level air samples at Quillayute, Washington in March 1972 and in northeastern Colorado in June 1972. The elapsed times between the beginning of droplet and/or ice crystal coalescence and the arrival of the precipitation at ground level, calculated on the basis of the $^{39}Cl/^{38}Cl$ ratios in the precipitation, averaged 50 minutes at Quillayute. In northeastern Colorado the calculated times averaged 70 minutes, except for a few samples near the middle of several storms, which yielded calculated times of 6 to 29 minutes. The $^{39}Cl/^{24}Na$ ratios in the precipitation indicated that droplets growing by condensation experienced an increased rate of capture of newly formed cosmogenic radionuclides because of their increasing size and in northeastern Colorado because of their vertical displacement in the thunderstorm updrafts. (auth)

21092 (BNWL-1751(Pt.1), pp 117-119) PLUTONIUM CONCENTRATIONS IN SURFACE AIR AT RICHLAND, WASHINGTON. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The atmospheric concentrations of ^{238}Pu and ^{239}Pu were measured in surface air samples collected at Richland, Washington from 1963 to 1972. (CH)

21093 (BNWL-1751(Pt.1), pp 120-122) ATMOSPHERIC RADIONUCLIDE CONCENTRATIONS AT RICHLAND, WASHINGTON AND AT POINT BARROW, ALASKA. Thomas, C. W.; Young, J. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The fallout radionuclide concentrations in surface air have been measured continuously at Richland, Washington (45°N) and at Point Barrow, Alaska (71°N) by filtering large volumes of air through membrane filters and then analyzing the filters by gamma-ray spectrometry. Data are presented on the concentrations of ^{90}Sr, ^{238}Pu, and ^{239}Pu during 1962 through 1971. (CH)

21094 (BNWL-1751(Pt.1), pp 123) CONCENTRATION OF ^{99}Tc IN ENVIRONMENTAL SAMPLES. Thomas, C. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Preliminary results on the concentration of ^{99}Tc in surface air taken October 1970 at Richland, Washington indicated a value less than 0.012 dpm/10^3 scm. If it is assumed that ^{99}Tc and ^{137}Cs are present in air at ratios similar to their fission yields, the ^{99}Tc concentration in surface air is estimated to be 0.0017 dpm/10^3 scm. This preliminary measurement would indicate that the ^{99}Tc concentration in surface air could possibly be as much as 7 times higher than would be predicted from fission. Such a value would seem entirely reasonable since substantial fractionation between the 99 and the 137 fission yield chains may occur shortly after detonation. Additional samples are presently being analyzed to determine actual rather than upper limit values for ^{99}Tc. (CH)

21095 (BNWL-1751(Pt.1), pp 123-127) EDDY DIFFUSIVITY AND COSMOGENIC RADIONUCLIDES. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

An experiment in which vertical profiles of certain cosmogenic radionuclides (^{7}Be, ^{39}C, and ^{24}Na) are used to infer the vertical profile of the eddy diffusivity in stable layers of the troposphere is described. (auth)

21096 (BNWL-1751(Pt.1), pp 127-130) VERTICAL PROFILES OF AITKEN NUCLEI. Alkezweeny, A. J. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Vertical profiles of Aitken nuclei (particles below 0.1 microns in size) in the atmosphere were determined over several locations in Washington State. It was found that the nuclei concentration either decreases or is nearly the same with altitude up to about 8000 feet. Above this level, the concentration continuously increases, even exceeding its value near the ground in some instances. (auth)

21097 (BNWL-1751(Pt.1), pp 131-134) AIRBORNE MEASUREMENT OF AEROSOL PARTICLE SIZE DISTRIBUTIONS. Alkezweeny, A. J. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The concentration and size distributions of aerosol particles were measured over Seattle and over the ocean in samples collected dry air samples mounted on aircraft. It was found that the concentrations of particles of all sizes decrease considerably above the temperature inversion level. (auth)

21098 (RA-44) GROSS RADIOACTIVITY IN AIRBORNE DUST. Results of Measurements During 1968. van Dongen, R.; Moonen, H. P.; Wolf, H. J. (Rijks Instituut voor de Volksgezondheid, Bilthoven (Netherlands). Laboratorium voor Stralingsonderzoek). Aug 1969. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Gross long-lived α, β, and γ activities of airborne dust collected at De Bilt/Bilthoven, The Netherlands, during 1968, are reported. (auth)

21099 (SCPRI(RM)-2-1973) REPORT OF ACTIVITY, FEBRUARY 1973. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

This monthly report of the SCPRI presents an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), seawater around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr, and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba, and ^{140}La, ^{90}Sr, ^{106}Ru, and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

21100 (SCPRI(RM)-2-1973(Suppl.)) ANNEX TO MONTHLY REPORT, FEBRUARY 1973. Detail of Results of Measurement. (Service Central de Protection Contre Les Rayonnments Ionisants, le Vesinet (France)). 1973. 24p. (In French).

Measurement tables concerning the surveillance of the environment (see also the SCPRI-RM-02-1973 report) are presented. (FR)

21101 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 6, 376-386(Jun 1973).

Data are presented on the gross β activity due to fallout in samples of surface air and precipitation collected at various locations throughout the USA during February 1973. Data are also included on samples collected at selected locations in Canada, Central America, and South America, and on the content of ^{238}Pu and ^{239}Pu in samples collected from selected sites in the USA. (CH)

21102 PRELIMINARY RESULTS OF MEASUREMENTS OF THE CONCENTRATION OF Rn AND ThB IN THE AIR DURING 1970. Kolarova, H. Meteorol. Zpr.; 26: No. 3, 86-92(26 Jun 1973). (In Czech).

For measurement of concentration of radon and thoron decay products the method of filtration was used. Activities of individual elements were computed by the analysis of decay curves of collected aerosol obtained from the daily sampling of the air aerosol with membrane filters. (auth)

21103 EFFICIENCY OF MEASURES OF DECREASING THE CONCENTRATION OF RADON DAUGHTER PRODUCTS IN THE AIR AND MORBIDITY RATE OF WORKERS AT A POLYMETAL MINE. Al'terman, A. D.; Bykhovskii, A. V.; Khodzhimatov, A. Kh. Gig. Sanit.; No. 7, 49-53(Jul 1973). (In Russian).

Introduction of a complex of sanitation measures at a polymetal mine diminished the content of radon daughter products in the mine air from 4.5 to 0.3 of mean annual concentration, decreased the mean content of dust from 4.3 to 1.4 mg/m^3, improved the sanitary service of workers, and brought about a 2-fold and more increase of the air current rate in the mines. A significant alleviation of the gravity of diseases of respiratory organs, of ocular, and oral mucosa was noted among the coal hewers and no practical changes in the signs of similar diseases could be traced among the rest of the workers. This fact evidences a favorable effect produced by the decrease of the content in the air of both radioactive and nonradioactive aerosols on the morbidity rate, than the negative effect of the increase of the air current rate in the mines on the health of workers. (auth)

21104 CONTROL OF RADON AND ITS DECAY PRODUCTS IN THE MINES. Riyabov, N. V.; Stas, K. N. (State Committee

on Atomic Energy, Moscow). pp C.2.1-C.2.6 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The main characteristic that differentiates uranium mines from other atomic enterprises is in that the most important and fundamental factor of radiation danger is the pollution of the air by radon and its daughter products, leading to a recurrent irradiation of the lung tissue of the miners and subsequently to an increase in the death record from lung cancer. Therefore, the greatest impact is made by the alpha radiation of the short half-life decay products of radon settling in the lungs. The concentration in the air of such products must be placed under permanent control. There is a second characteristic in the atmosphere of uranium mines; we have the presence of several short half-life isotopes contained in a unique chain of decay. The limited half-life of each isotope is responsible for the fact that between them, and between Rn and RaA, there may appear different deviations from radioactive equilibrium depending from prevailing ventilation conditions. Therefore the comparative evaluation of the irradiation condition and the determination of the degree of irradiation of the mine workers must take place jointly with the calculation of the contribution of each isotope. This of course requires a knowledge of their concentrations or of their rate of entry in the organism. (BE)

21105 LOCAL FALLOUT FROM LAND SURFACE NUCLEAR EXPLOSIONS: A MATHEMATICAL MODEL AND ITS APPLICATION. Gut, J. Diss. Nr. 4609. Zurich; Eidgenoessische Technische Hochschule (1971). 78p. (In German).

Thesis.

The specific objective of this work is the local fallout from land surface nuclear explosions. In the first part, a mathematical model of nuclear cloud dimensions, particle activity distribution, activity transport, and contamination of fallout area is presented. Special attention is given to particle frequency and activity distribution, where recent publications show greater amounts of relative activity with smaller particles. In the second part, the computer program ELOFA (Estimation of Local Fallout Area) is described. The program calculates gamma dose rates in the local fallout area under consideration of detailed wind structure. For the application as fallout predictor, a number of defined dose rate lines can directly be drawn on a topographical chart by means of an automatic coragraph plotter. (auth)

21106 EMANATION CHARACTERISTICS OF RADON GAS INTO MINES AND THEIR EFFECTS ON THE CONCENTRATIONS OF AIRBORNE RADON DAUGHTERS IN MINE ATMOSPHERES. Thompkins, R. W. (Queen's Univ., Kingston, Ont.). (1972). vp.

From international dust meeting; Bonn, Germany (26 Sep 1972).

The manner in which the parent radon gas emanates into a mine and the growth of radon gas concentrations in a mine are discussed. Evidence of radon concentrations in non-uranium mines is also provided. An engineering criteria for the design of uranium mines to minimize radon emanations is given. (auth)

21107 FALLOUT FROM NUCLEAR WEAPONS TESTING AND INTERHEMISPHERIC TRANSPORT OF NUCLEAR DEBRIS. Noyce, J. R.; Moore, D. T.; Sherwood, J. D.; Daniel, P. R.; Beck, J. N.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Health Phys.; 25: No. 2, 109-114(Aug 1973).

Three Chinese thermonuclear weapons tests were the major sources of nuclear debris in the Northern Hemisphere from late 1968 through mid-1970. Isotopic ratios of debris from each of these tests varied with time in a similar manner. After a sharp initial peak, the $^{89}Sr/^{90}Sr$ ratios showed a less zig-zag pattern and increased slowly for several months after each nuclear test. Radioactive debris was detected from a French nuclear test series conducted in the Southern Hemisphere during the summer months of 1970. Interhemispheric transit times were between 1 and 2 months. French debris may have crossed the Equator via Hadley Cell Circulation. (auth)

Soil

21108 (BNWL-1755) TUMBLEWEED AND CHEATGRASS UPTAKE OF TRANSURANIUM ELEMENTS APPLIED TO SOIL AS ORGANIC ACID COMPLEXES. Price, K. R. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. Contract AT(45-1)-2130. 15p. Dep. NTIS $3.00.

Plant uptake of radioactive waste materials is a biological interaction important to the environmental management of waste storage sites. This study on the uptake of ^{241}Am, ^{244}Cm, ^{237}Np, and ^{239}Pu from soil by plants demonstrates that shoot uptake is clearly influenced by the chemical form of the transuranic. It is unclear at this time whether soil or plant mechanisms, or both, are responsible. Future studies are planned to investigate these aspects. The observation that some organic acids suppress plant uptake of americium and curium will be investigated further to evaluate the use of soil additives to suppress plant uptake of transuranics. Test results indicate that organic acid complexes of plutonium such as oxalate or citrate can increase plant uptake when added to soil as compared to uptake from dilute nitric acid solutions. (auth)

21109 (RFP-Trans-140) CONTRIBUTION TO THE STUDY OF THE MIGRATION OF RUTHENIUM-106 IN SOILS. Amy, J. P. Feb 1971. Translated from CEA-R-4168. 60p. (A). Dep. NTIS $5.00.

The migration of ^{106}Ru in soils was studied; two solutions of nitrosylruthenium complexes (state in which ^{106}Ru is released from the Marcoule plant) and a noncomplex ruthenium chloride solution were used in experiments on the mobility of the radioelement, the solutions being percolated through columns containing the soils. The migration depended on the degree of ionization: anionic forms were found to be mobile in the soil, a large fraction being found in the percolate, whereas cationic states were sorbed much more quickly. The nature of the soil also affected the migration process; Ru migrated deeply in sandy soils, whereas it was strongly sorbed by the muddy fractions of soils with a mud sand texture. The mobility of Ru in the soils studied was found to be more dependent on the solution percolation rates than on the particle size distribution; these two factors are, however, closely related. (One chapter of this report appeared as RFP-Trans-113). (FR)

21110 STRONTIUM-90 AND CESIUM-137 LEVELS IN SOILS OF VARIOUS TYPES AT NIIGATA PREFECTURE, JAPAN. Kawase, K.; Yokoyama, E. (Niigata Univ., Japan). J. Radiat. Res.; 14: No. 1, 40-48(Mar 1973).

Strontium-90 and ^{137}Cs contents of soils, mostly from radioactive fallout from past nuclear explosions, were estimated at 15 locations in Niigata Prefecture. Fifteen locations include paddy fields, meadow, grass fields, forest, and dried lagoon. Strontium-90 contents of the soils, except forest and dried lagoon, ranged from 81 to 315 mCi/km^2 and ^{137}Cs ranged from 234 to 451 mCi/km^2. These results indicate that the soils except forest and lagoon were highly contaminated with ^{90}Sr and ^{137}Cs from radioactive fallout. High activities of ^{90}Sr and ^{137}Cs were noted in rice paddy fields. Strontium-90 of 316 mCi/km^2 of Muramatsu Town and ^{137}Cs of 451 mCi/km^2 of Gosen City are probably the highest values recorded in Japan. These high values may reflect the high annual rainfall of these areas. Relatively low ^{90}Sr and ^{137}Cs levels of forest soils and dried lagoon suggest that ^{90}Sr in strongly acidic, sandy, and low humic soils was washed away rather easily by water and that ^{137}Cs in very reductive paddy soil and in volcanic ash soil was also easily removed by water. The distribution of ^{90}Sr and ^{137}Cs in relation to various depth of soils indicates that the monitoring of two nuclides in soils should be carried out from the soil sample dug up to 50 cm depth. (auth)

Water

Refer also to abstract 20725.

21111 (BNWL-1705) INFORMATION STORAGE AND RETRIEVAL SYSTEM FOR WELL HYDROGRAPH DATA USER'S MANUAL. Friedrichs, D. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. Contract AT(45-1)-2130. 70p. Dep. NTIS $5.45.

A collection of programs used in storage and retrieval of well hydrograph data is described. The programs are used on either a UNIVAC 1108 computer or a PDP-9 computer, depending on their function. The UNIVAC 1108 computer programs are transmitted from the PDP-9 to the 1108 via a data communication link for execution. The computations are returned to the PDP-9 via the data link and manipulated by the PDP-9 computer programs to provide the required output options. Certain preliminary programs perform preparatory functions prior to the execution of the main PDP-9 computer program DSWELL, which is the actual data retrieval and display program. The function of each of the programs is described in detail. (auth)

21112 (COO-3566-4) DISTRIBUTION OF SOME CHEMICAL ELEMENTS BETWEEN DISSOLVED AND PARTICULATE PHASES IN THE OCEAN. Period covered: August 1972-April 1973. Spencer, D. W.; Brewer, P. G.; Frew, Nelson, Sachs, P. L.; Smith, C. L.; Murray, J. W. (Woods Hole Oceanographic Institution, Mass.). 1973. Contract AT(11-1)-3566. 120p. Dep. NTIS $8.00.

Investigations were continued on the Cariaco Trench samples collected during cruise 60 of the R/V Atlantis II during August,

1971. Data on mean potential temperatures show that the deep water of the Cariaco Trench is warming with time. Data are tabulated for ^{14}C in the Cariaco Trench from depths of 25 to 1350 m. Graphs and Tables are presented to show trace metal composition of suspended matter. Methods for determination of ^{210}Pb in both dissolved and particulate states in seawater are briefly described. As a part of the program for using ^{210}Pb as a tracer, methods were developed for determining the concentration of stable lead in seawater. Experiments are described for determining adsorption of trace metals onto the hydrous manganese dioxide surface. Studies on carbon, nitrogen, and phosphorus in the Black Sea are reported. Studies on distribution and flux of trace elements between dissolved and particulate phases in the Black Sea are also reported. (HLW)

Ecosystems and Food Cycles

Refer also to abstracts 21315, 23922, 23937, 23939, 23961, 24006, 24008, and 24019.

21113 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 6, 371-375(Jun 1973).

Data are presented on the gross α and β activity and content of tritium in samples of drinking water collected at various locations throughout California, Nevada, and Utah during December 1972. (CH)

21114 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 6, 357-370(Jun 1973).

Data are presented on the content of fallout ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, and ^{140}Ba in milk samples collected throughout the USA during February 1973. Data are included on the content of ^{137}Cs and ^{90}Sr in milk samples collected at selected locations in Canada, Central America, and South America. (CH)

21115 SUMMARY OF ENVIRONMENTAL MONITORING AT PHILADELPHIA, 1958–1971. Lieberman, J. E. (Public Health Dept., Philadelphia); Ice, R. D.; Green, M.; McGrattan, R. Radiat. Data Rep.; 14: No. 6, 333-350(Jun 1973).

The City of Philadelphia maintains an environmental radiation surveillance program for evaluating the environment of the Delaware Valley. The program has evolved from the initial goals of setting operational guides for the collection and analyses of data at sites of nuclear ship operations, through preoperational radiological data collection associated with the construction of the N.S. Savannah, through a nuclear weapons fallout evaluation, to the present objective of providing environmental surveillance of nuclear facilities. A 13-year compilation of environmental data from the City of Philadelphia is presented. Included are gross alpha and gross beta results of raw and treated surface waters, gross beta results of air samples, and strontium-90 and iodine-131 quantities in pasteurized milk. (auth)

21116 SIGNIFICANCE OF RADIOACTIVE CONTAMINATION OF FOODSTUFFS. Diehl, J. F. (Inst. fuer Strahlentechnologie, Karlsruhe, Ger.). Katastrophenmedizin; 6: No. 4, 52-56(1970). (In German).

The radioactive contamination of foodstuffs after long-term exposure to minor doses such as subsequent to nuclear test explosions and in the case of acute contamination resulting from a nuclear attack is discussed. According to present-day knowledge, it can be safely assumed that in both cases the isotopes ^{90}Sr and ^{137}Cs will not be of prime importance with respect to food contamination, whereas ^{131}I will be particularly dangerous for children, as it will be incorporated via contaminated milk. During the immediate post-attack period, the solubility of radioactive fallout will be very low and will rise to a maximum of approximately 50% during the following years so that during this first period only a limited amount will be incorporated by grazing animals. Plants, on the other hand, are very radiosensitive, and doses from 500 to 10,000 rad may reduce the crop yield considerably; added to this is the destruction of food in stock and means of transport. Thus the risk arising from radiation damage from contaminated foodstuffs following a nuclear attack is less important, as compared to external radiation exposure and destruction of crops and the resulting dearth of food. Hence the author does not hold it very useful to continue research on food decontamination, whereas regular control of food with regard to a possible contamination is indispensable, also with respect to environmental contamination due to the operation of nuclear power stations. (GE)

Radiometric Techniques

Refer also to abstracts 20671, 21112, 21377, 21378, 21431, 21460, 21473, 21662, and 23914.

21117 (CONF-721091-, pp P10.p1-P10.p6) USE OF RADIOISOTOPE TRACERS IN COASTAL SEDIMENT DISPERSION STUDIES. Bain, C.A.R.; McMurray, W.R.; Van As, D.; Retief, D. F. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The use of surface-labeled and volume-labeled radioisotopes and tracers in coastal sediment dispersion studies is described. Data are collected in situ with a scintillation detector and recorded on magnetic tape. Results of field tests for various sites along the South African coast are given in the form of isoactivity contour maps. (auth)

21118 (CONF-721091-, pp P11.p1-P11.p5) RADIOISOTOPES IN THE DETERMINATION OF DISPERSION COEFFICIENTS IN ESTUARIES FOR POLLUTION CONTROL STUDIES. Bain, C. A. R. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

A short review of some nuclear techniques used in differing river and estuary flow problems that may be linked to pollution control studies is given. This is followed by the discussion of radioactive tracer techniques developed locally for the determination of longitudinal dispersion coefficients in estuaries. The choice of tracer, injection of tracer, procedures in field collection of data, and data analysis are discussed. (auth)

21119 (CONF-721091-, pp P23.p1-P23.p9) NUCLEAR TECHNIQUES IN RHODESIAN HYDROLOGY. Wurzel, P. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The nuclear techniques used in three areas of Rhodesian hydrology, geohydrology, stream-flow gaging, and sedimentation are briefly described. The single-well point-dilution technique to measure underground water flow rates utilizing gamma-emitting radiotracers is discussed and compared with the classical time/distance tracer method. Single borehole groundwater direction measurement techniques are also highlighted. Mention is made of the use of artificial radioisotopes in the measurement of effective porosity, and the delineation of the major zones of flow in boreholes sited in the crystalline rocks. The dilution method for streamflow gaging with radioisotopes has found wide acceptance in Rhodesia. Sampling techniques have been evaluated and the total count and integrated sample method are now used routinely for measuring flows up to 10 m^3/s. The tracers used are iodine-131, chromium-51 EDTA, and gold-198. For medium-to-low flows the mixing length formula of Hull adequately predicts the mixing length. For larger flows procedures requiring tracer enrichment are rejected. Tritiated water is the favored tracer for flood-flow measurement. Health hazards are minimal and costs of tracer extremely low. Finally, a brief description is given of a nuclear gage to measure the sediment load in a stream. A transmission-type instrument, based on a design of the IAEA is to be built into a 6.1 m Parshall flume so that a continuous record of sediment passing a given cross section may be obtained. (auth)

21120 (CONF-721091-, pp P26.p1-P26.p11) ENVIRONMENTAL RADIOISOTOPES IN WATER STUDIES. Verhagen, B. T.; Sellschop, J. P. F. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Tritium (^3H) and radiocarbon (^{14}C) are found in nature and can be used in the study of water movement and storage. Tritium (radioactive hydrogen), with a half-life of 12.3 yrs, is produced in the atmosphere by cosmic rays and, when oxidized, becomes part of rainwater at an atomic concentration of about $1:10^{17}$. Decay of tritium during storage and flow in comparatively isolated systems allows for the dating of water back to the time of rain recharge. Allied with other hydrological data, measurements of tritium concentration allow for assessments of groundwater flow, reservoir turnover times, storage capacities, and other water-inventory investigations. The rise in concentration due to bomb fallout over the last two decades has facilitated the study of rainwater infiltration into the soil, and of other recharge mechanisms. The time scale of hydrological phenomena that can be studied with tritium ranges from months to about 100 yrs. Radiocarbon is produced by similar processes and, in the oxidized form of CO_2, has a natural atomic abundance of about $1:10^{12}$. Carbonate exchange in the soil introduces radiocarbon into groundwaters as part of the dissolved bicarbonates. Dating and turnover studies can be undertaken as with tritium, but on a much longer time scale determined by the radiocarbon half-life of 5,730 yrs. The delay involved in the soil exchange mechanism, and the imperfectly known exchange factor, limit the accuracy of its application to short-term processes. However, the increase in the radiocarbon concentrations due to bomb fallout allows for short-term studies in favorable situations. Some examples of hydrological investigations

employing both isotopes, in Southern Africa and elsewhere, are given to illustrate the present state of the art and possible future applications. Special emphasis is given to arid zone hydrology. (auth)

21121 (CONF-721091-, pp P28.p1-P28.p7) DETERMINATION OF GROUNDWATER RECHARGE WITH TRITIUM. Vogel, J. C.; Van Dijken, M. 1972.

From national conference on the technological applications of nuclear techniques. 1972; Pelindaba, South Africa (12 Oct 1972).

All showers of rain contain small amounts of radioactive tritium, which emanates mainly from two sources, namely low concentrations of tritium produced by cosmic rays, and increased concentrations of tritium resulting from nuclear bomb tests since 1952. By taking soil moisture samples at various depths, and by determining the tritium concentration in the groundwater, the age of the water that has penetrated the soil to that particular depth can be determined. Water with a tritium content of less than 7 tritium units (T.U.) emanated from rainfall before 1957, values between 7 and 12 T.U. from rain between 1958 and 1962, and values exceeding 30 T.U. from rainfall since 1963. By using the abovementioned data, the extent to which the groundwater was recharged could be derived. Particulars are given of experiments conducted in Kalahari sand, at Lobatsi in Botswana and at Elandsfontein, Southern Witwatersrand. (auth)

21122 (CONF-721091-, pp P29.p1-P29.p4) SOME APPLICATIONS OF RADIONUCLIDES IN HYDROLOGY, MINING, AND AGRICULTURE. Guillot, P. (CEA, Saclay, France). 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The applications described concern the use of tracers in hydrology, of radioisotopes in x-ray fluorescence, and of neutron activation analysis in industry and mining. Finally the application of neutronic measurements to research on the water cycle in agriculture is discussed briefly. (auth)

21123 (CONF-721091-, pp P34.p1-P34.p3) ACTIVABLE TRACERS IN THE CONTROL OF POLLUTION AND THE STUDY OF ENVIRONMENTAL TRANSPORT PROCESSES. Van As, D. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Activable tracers are often more convenient to use than radioactive tracers, especially when studying large-scale environmental processes. These tracers can be either stable elements added to the particular medium that they then uniquely label, or they can be a single trace element or combination of trace elements that are naturally present in the medium. The presence and concentration of these elements can be determined at extremely low levels ($\sim 10^{-9}$g) by means of nuclear techniques such as neutron activation and x-ray fluorescence. The application of activable tracers for the investigation of atmospheric dispersion ecological concentration processes and the characterization of aquifers and air masses in South Africa is briefly described. (auth)

21124 (CONF-721091-, pp P35.p1-P35.p21) SOME RECENT DEVELOPMENTS AND APPLICATIONS OF NUCLEAR TECHNIQUES IN THE EXPLOITATION OF MINERAL RESOURCES. Clayton, C. G. (AERE, Harwell, Eng.). 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The particular advantages of nuclear techniques for mineral analysis in exploration, in mine development and in on-stream process control are now being recognized and a wide variety of applications have been identified. Radiation instruments which incorporate these techniques are now in routine use in many different areas of activity in the mining industry. The most important recent developments in techniques and applications are described and examples are given of instruments for use in seabed surveying, bore-hole logging and in mine sample and on-stream analysis. (auth)

21125 (CONF-721091-, pp R6.b1-R6.b4) APPLICATIONS OF ISOTOPE EXCHANGE IN SOIL RESEARCH. Deist, J.; Kotze, W. A. G. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

To study a soil in its natural state, methods and techniques should be used that would cause the least disturbance of the equilibria existing between the various phases of the soil system. The isotope technique is ideally suited for such studies and a number of applications of the isotropic exchange phenomenon are discussed below. Plants can absorb their nutrients only from the soil solution, the composition of which is determined by the exchangeable ions on the solid phase. By adding a radioisotope to an equilibrium suspension of soil, the amount of exchangeable ions (E-value) as well as the rate at which they exchange, can easily be measured. The amount of potentially available nutrients for plants in a soil can also be determined by means of the isotope technique. When a radioisotope of the element concerned is intimately mixed with the soil, it undergoes all the normal reactions of the element present in the soil, thereby forming a labeled labile pool of the element in the soil. The specific activity of the element in the plant is, therefore, equal to that in the pool, and the amount of element in the soil that contributes towards the available pool (the so-called L-value) can be calculated. It was shown experimentally that the L-values obtained in this way are independent of experimental conditions such as crop, growing period and amount of isotope or carrier element added. The L-value of the soil can therefore be determined in the presence of large amounts of added fertilizer. Because the fertilizer element is labeled, the total amounts of nutrient taken up by the plant, can be divided into that taken up from the fertilizer and that absorbed from the soil. (ERB)

21126 (CONF-721091-, pp R24.b1-R24.b9) USE OF RADIOACTIVE ISOTOPES AS GROUNDWATER TRACERS TO DETERMINE THE EFFECTIVE POROSITY OF GROUNDWATER AQUIFERS. Du Toit, G. J.; Bredenkamp, D. B. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

A technique is discussed whereby the effective porosity of an aquifer can be determined by introducing a radioactive tracer into a borehole with subsequent recovery of the tracer at an adjacent pumping site. On account of the relatively large dispersion that the tracer undergoes, the choice of a reference point on the recovery graph is an important factor. Reasons for the dispersion of the tracer are advanced. Two transformations of the recovery graph are necessary: first, to make the graph independent of the pumping rate and, secondly, to restore the symmetry of the graph. The methods whereby the tracer is introduced into a borehole, as well as its later detection, are discussed. Iodine-131-labeled NaI and ^{51}Cr-EDTA are used as tracers in three field tests representative of characteristic aquifers. These were an alluvial river bed, a dolomitic aquifer, and a dolerite dyke. The results obtained from these experiments indicate that this technique can be used successfully but it was found that the dispersion of the tracer is great and therefore the choice of the reference point should be more specific. (auth)

21127 (CONF-721091-, pp R25.b1-R25.b5) USE OF ISOTOPES IN SOIL PHYSICAL STUDIES. Van der Westhuizen, M. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The complete water balance of a growing crop is described and every component of the balance is mentioned. Use of isotopes in the determination of every component is discussed. For the measurement of soil moisture content one of the oldest isotope applications, namely the neutron soil moisture meter, is described. For soil density measurements use is made of the absorption of gamma rays. Evaporation from the soil can be calculated by determining the tritium concentration profile with depth. In the case of transpiration from a tree, it seems that there is a relation between the tritium concentration of the water applied, the tritium concentration of the water in the leaves, and the transpiration rate. In determining the deep percolation to the water table, isotopes can really be of great help. If a layer of water marked by tritium or deuterium is placed in soil, this layer is pushed down by the amount of water flowing to the water table. Much information can thus be obtained by measuring the depth of such a marked layer. For water movement underneath the water table different isotopes can be used to determine the velocity and direction of the movement. (auth)

21128 (COO-3132-4) ORIGINS OF DEEP-SEA SEDIMENTS AND THEIR VARIATIONS WITH TIME. Annual progress report No. 4. Biscaye, P. E. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). Jun 1973. Contract AT(11-1)-3132. 17p. Dep. NTIS $3.00.

Processes that affect the transport of marine sediments were investigated using natural Rn, ^{226}Ra, ^{228}Ra, and ^{228}Th as tracers. Data are reported on the content of sedimentary particles in seawater samples collected at various depths. The use of Rb/Sr isotope ratio for dating ocean sediments was investigated. (CH)

21129 (IFA-MR-39-1973) METHOD WITH RADIOTRACERS AND EXPERIMENTS IN HYDROKARST STRUCTURES. Gaspar, E., (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

Difficulties encountered in the use of radioisotopes as tracers for studies of ground water flow in limestone regions characterized by sinkholes and underground streams are discussed. Results are reported from studies using ^{131}I Na or tritium as

tracers following injection into sinkholes or streams as they disappeared underground. Samples were collected from sinkholes and boreholes for radiometric analysis. (CH)

21130 (NVO-412-1) ATS: AMARGOSA TRACER STUDY. Program Manual. Coston, A. P. (Computer Science Corp., Las Vegas, Nev. (USA)). May 1973. Contract AT(26-1)-412. 38p. Dep. NTIS $4.00.

Statistical analysis of hydrologic data, collected from sources such as wells, involves the input of this data into various statistical programs in a standard format. The package of statistical programs used by the USGS (U. S. Geological Survey) in this regard is called the STATPAC Package. Likewise, the standard format is termed the STATPAC format. The package is a collection of computer programs for the reduction and statistical analysis of data which can be presented in the form of a two-dimensional matrix. Program ATS takes the initial data collected and outputs it in the standard STATPAC format on magnetic tape. The data input into ATS is coded as julian dates, time, tritium concentration, and/or julian date, time, sodium concentrations, chloride concentrations, Rhodamine WT concentrations, specific conductance. The STATPAC tape that results is sorted by Julian date and time. The cumulative pumping discharge for each sample of data is calculated by ATS and added as columns to the STATPAC tape. The tape is a binary one consisting of n + 1 records where n is the number of samples (rows) in the data matrix. Each row contains measurements of the sample properties. The tape may be later used as input to the STATPAC system or input to the interactive graphics program GRAND. (auth)

21131 (STI/DOC-10/145) TRACER TECHNIQUES IN SEDIMENT TRANSPORT. Technical Reports Series No. 145. Panel Meeting Held at Saclay, France, June 21-25, 1971. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 240p. (CONF-710665-). IAEA $9.00.

Separate abstracts were prepared for 10 of the 18 papers presented. The other eight papers discuss conventional sedimentology methods and fluorescent tracer techniques. (ERB)

For abstracts of individual papers see: 21135-21141, 21377, 21378, and 21662.

21132 DATING OF PRE-HISTORICAL POTTERY BY THERMOLUMINESCENCE. Mejdahl, V. (Danish Atomic Energy Commission, Risoe). Kosmos (Stockholm); 48: 57-60(1971). (In Danish).

A technique for absolute dating by thermoluminescence of pottery found in Denmark is described. Quartz and feldspar grains of the size 0.3 to 0.5 mm are used. The accumulated dose is determined, as well as the radiation intensity by $CaSO_4$:Dy and $CaSO_4$:Mn. (Sweden)

21133 UNRELIABILITY OF THE ^{14}C METHOD FOR ESTIMATING PRIMARY PRODUCTIVITY IN EUTROPHIC DUTCH COASTAL WATERS. Gieskes, W. W. C.; van Bennekom, A. J. (Netherlands Inst. for Sea Research, Texel). Limnol. Oceanogr.; 18: No. 3, 494-495(May 1973).

Secretion of mucus by colony-forming algae may contribute to the underestimation of primary productivity with the ^{14}C method if only the particulate, not the dissolved organic, fraction is taken into account. Silicate enrichment from glass ^{14}C ampoules may lead to overestimation. (auth)

21134 BEHAVIOR OF PHOSPHORUS IN A FERRALITIC SOIL SUBJECTED TO DIFFERENT AGRONOMIC TREATMENTS. Pichot, J.; Truong, B.; Burdin, S. (Institut de Recherches Agronomiques Tropicales, Nogent-sur-Marne, France). Agron. Trop. (Paris); No. 2, 131-139(Feb 1973). (In French).

Soil samples from the Central African Republic were examined. They were analyzed using chemical methods and an isotopic dilution method based on measuring the specific radioactivity of phosphorus in plants (determination of L value). The results demonstrate the important effect of the treatments on the phosphorus contents of the soil. In addition, the results emphasize the advantages of the Saunder methods and the determination of L values for pots containing vegetation that are particularly useful when studying the relations between variables. (FR)

21135 PRINCIPLES OF TRACER METHODS. Sauzay, G. (International Atomic Energy Agency, Vienna). pp 9-12 of Trace Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

Artificial and natural tracers are defined and their use in small-scale and large-scale investigations respectively is discussed. The application of tracers in sediment transport studies is also discussed. (ERB)

21136 USE OF ARTIFICIAL RADIOACTIVE TRACERS IN FRANCE. Courtois, G. pp 71-80 of Trace Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The use of artificial radioactive tracers in sedimentology in France is discussed. The technology and methodology are reviewed and the applications of nuclear gauges is cited. (ERB)

21137 SOME APPLICATIONS USING ARTIFICIAL RADIOACTIVE TRACERS IN GERMANY. Pahlke, H. (Versuchsanstalt fuer Wasserbau und Schiffbau, Berlin). pp 81-96 of Trace Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The uses of artificial radioactive tracers in hydrology and sedimentology in Germany are discussed. Sand migration studies have been conducted in the Federal Republic of Germany using both radioisotopes and luminophors. (ERB)

21138 USE OF ARTIFICIAL RADIOACTIVE TRACERS IN THE UNITED KINGDOM. Smith, D. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 97-102 of Trace Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The use of artificial radioactive tracers in the study of river, estuarine, and coastal sediment movement studies in the United Kingdom is discussed. The radioactive tracers, tracer materials, deposition procedures, and survey methods are briefly reviewed. Problems involved in the interpretation of the results are cited. (ERB)

21139 USE OF ACTIVATABLE TRACERS. de Groot, A. J.; Allersma, E.; de Bruin, N.; Houtman, J. P. W. (Inst. for Soil Fertility, Groningen, Netherlands). pp 151-166 of Trace Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The use of activatable tracers in the study of sediment transport is discussed. The method involves the labelling of sediments with selected elements and the subsequent analysis of samples by neutron activation. The methodology and results of sediment transport studies using cobalt and tantalum as tracers are presented. (ERB)

21140 SEDIMENT LABELLING WITH RADIOACTIVE ISOTOPES. Caillot, A. (CEN de Saclay, Gif-sur-Yvette, France). pp 169-176 of Tracer Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

Several methods are available for labelling sediments (shingle, sand, silt). However, any method used must meet the following criteria: mass labelling; high adherence factor and inseparability from carrier; the tracer must be representative of the medium; appropriate tracer mass; and adherence to certain technical conditions.

21141 NATURAL RADIOACTIVE TRACERS AND THEIR USE IN BELGIUM. Lithological Maps of the Bottom of the North Sea off the Belgian Coast and of the Scheldt Estuary Constructed on the Basis of Natural Radioactivity Measurements. Bastin, A. (Institut Royal des Sciences Naturelles de Belgique, Brussels). pp 179-200 of Tracer Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From Panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The use of natural radioactive tracers in the preparation of lithological maps of the bottom of the North Sea off the Belgian coast and of the Scheldt estuary is discussed. The use of natural tracers overcame the problems regarding the representativeness of the samples. (ERB)

21142 SOME FACTORS INFLUENCING THE INTERPRETATION OF SOIL SOLUTE-WATER INTERACTIONS. Corey, J. C. (E. I. du Pont de Nemours and Co., Aiken, SC); Nielson, D. R. pp 87-110 of Soil-Moisture and Irrigation Studies. II. Vienna: International Atomic Energy Agency (1973).

From Panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

The effect of tracer, soil, water content and biological population on soil-solute-water interaction studies is reviewed. Radionuclides, particularly tritium, and anions such as chlorides are the tracers discussed. Water content has a drastic effect upon the movement of solutes in soil and upon soil-solute-water interactions. Studies discussed suggest ways to improve leaching efficiency by altering the manner in which water is applied. Methods for studying the interaction of biological populations with biodegradable substances are reviewed. (auth)

21143 ANALYZING SOIL WATER AND SOLUTE MOVEMENT UNDER FIELD CONDITIONS. Nielsen, D. R.; Biggar, J. W. (Univ. of California, Davis). pp 111-127 of Soil Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agency (1973).

From Panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Methods are reviewed for assessing water content distribution and water flux out of a soil profile using potential or diffusion equations and data obtainable by means of a neutron moisture meter or by tensiometers. Applicability of such measurements to field soils with the attendant variability are discussed together with movement of solutes in the profile. (auth)

21144 ISOTOPIC EVOLUTION OF COMMON LEAD. Sinha, A. K.; Tilton, G. R. (Carnegie Institution of Washington, DC). Geochim. Cosmochim. Acta; 37: No. 8, 1823-1849(Aug 1973).

The isotopic composition of lead from galenas and feldspars of granitic rocks covering a time span of 3600 m.y. is reviewed. New data are combined with data from the literature, all ratios being normalized to a fixed value for the isotopic composition of lead in an inter-laboratory reference sample. Comparison of feldspar and galena results show that the isotopic composition of initial lead in granitic rocks may be identical to, or more radiogenic than, that in coeval stratiform (or "single stage") ore deposits. The isotopic evolution of terrestrial lead over the past 3600 m.y. deduced from the stratiform ore data does not fit the closed system source. The data are best fitted to evolution models in which the value of μ ($^{238}U/^{204}Pb$ normalized to the present day) in the source has increased either over approximately the past 3.6 billion years or since the time of formation of the Earth. A limited number of high precision data for strontium likewise indicate open system isotopic evolution. In this system the Rb/Sr ratio appears to have decreased as a function of time. Physical models that explain the data are presented. Either mantle differentiation or crustal contamination processes could account for the change in μ in the source for the lead. The strontium data and some detailed studies of the isotopic composition of lead in oceanic volcanic rocks support mantle differentiation rather than crustal contamination. The exact nature of the mantle differentiation process cannot be specified, although empirical data favoring the existence of such a process are given. The best estimate of the age of the Earth, calculated with the data from 2750 and 3290 m.y.-old lead ores, is 4660 m.y. (auth)

21145 FISSION TRACK AGES OF SOME BUNDELKHAND GRANITES AROUND JHANSI. Nagpal, M. K.; Arora, A. D.; Nagpaul, K. K. (Kurukshetra Univ., India). Curr. Sci. (India); 42: No. 16, 570-572(20 Aug 1973).

Nine granite samples from different localities around Jhansi were dated by fission track method. The ages support the view that the region is affected by later granitization episodes in Aravalli and Delhi times. (auth)

21146 ISOTOPIC COMPOSITION OF OIL-FIELD BRINES FROM KETTLEMAN NORTH DOME, CALIFORNIA, AND THEIR GEOLOGIC IMPLICATIONS. Kharaka, Y. K.; Berry, F. A. F.; Friedman, I. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; 37: No. 8, 1899-1908(Aug 1973).

Deuterium and ^{18}O analyses were made on 25 formation-water samples from Miocene (Temblor Formation) and Eocene (McAdams Formation) reservoir rocks at Kettleman North Dome oil field, California, and on three surface water samples from Reef Ridge located about three miles to the west of the field. The $\delta\,^{18}O$ values obtained generally increase with depth and most probably are due to temperature controlled exchange reactions with carbonate cement and dissolved carbonate species. The δD values obtained seem to be controlled primarily by the membrane behavior of shales modifying the assumed original values. The contribution of isotopic exchange between water and clays cannot be evaluated at present. The isotopic data support the conclusions based on a detailed study of geology, hydrodynamics, and formation water geochemistry which indicate that: 1. The Temblor Formation waters are probably meteoric in origin concentrated chemically and isotopically by shale membranes, and 2. The McAdams Formation waters were most probably obtained by squeezing the original interstitial marine connate waters of deposition from the underlying Mesozoic sediments. (auth)

Site Surveys

Refer also to abstracts 21063, 21161, 21162, 21654, and 24027.

21147 (BARC-644) DISPERSAL AND UPTAKE OF RADIOACTIVE ELEMENTS IN THE TARAPUR ENVIRONMENT. Bhat, I. S.; Kamath, P. R.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 255p. Dep. NTIS (U. S. Sales Only) $14.75.

Data on the content of fallout ^{137}Cs, ^{131}I, and ^{90}Sr in marine and terrestrial ecosystems and in the human diet in the vicinity of the Tarapur nuclear power plant in India were collected during a pre-operational period to provide baseline data and identify critical population groups and critical exposure pathways. Fallout radionuclides were also used as tracers in studies on the movement of coastal waters at the Tarapur reactor site. Monitoring studies during the three-year operation period of the reactors have shown no waste discharges of concern for the environmental safety of the population. Representative members of the population have also been examined for radioactivity by whole-body counting and no increase has been observed. (CH)

21148 (BNWL-1751(Pt.1), pp 148-150) 1972 MICROCLIMATOLOGICAL MEASUREMENTS ON THE ARID LANDS ECOLOGY RESERVE. Thorp, J. M. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Daily and monthly microclimatology measurements on the Arid Lands Ecology Reserve continued on schedule during 1972. Micrometeorological and microclimatological data from various ALE Reserve study plots are being summarized by computer and distributed monthly to Reserve investigators. (auth)

21149 (DP-MS-71-89) VALUE OF CLIMATOLOGICAL DATA. Kauffman, G. E. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 21 Feb 1972. Contract AT(07-2)-1. 12p. (CONF-720352-1). Dep. NTIS $3.00.

From South Carolina Academy of Sciences annual meeting; Columbia, South Carolina, USA (24 Mar 1972).

Climatological records for the Savannah River Plant site, an area of about 315 square miles, fill a need for many different groups. Precipitation data are used in environmental studies, programs in both ecology and limnology, reforestation projects of the U. S. Forest Service, and in waste management studies by technical groups. The Power Department is concerned with temperature extremes and, in the summer, any corresponding high humidity. Weather records are frequently reviewed to aid in explaining some unanticipated results in laboratory experiments or production programs. Design engineers must know all climatological extremes for a given location so that appropriate safety factors can be considered in buildings or structures. (auth)

21150 (DP-MS-72-56) WATER-LEVEL FLUCTUATIONS DUE TO EARTH TIDES IN A WELL PUMPING FROM SLIGHTLY FRACTURED CRYSTALLINE ROCK. Marine, I. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1972. 29p. (CONF-721230-1). Dep. NTIS $3.50.

From symposium on fractured-rock groundwater systems; San Francisco, California, USA (4 Dec 1972).

At the Atomic Energy Commission's Savannah River Plant near Aiken, South Carolina, there are three distinct ground-water systems: the Coastal Plain sediments, crystalline metamorphic rocks, and a buried triassic basin. The Coastal Plain sediments include several Cretaceous and Tertiary granular aquifers and aquicludes, with a total thickness of about 305 m. Below these sediments, water occurs in small fractures in crystalline metamorphic rock (hornblende, schist, and gneiss, with lesser amounts of quartzite). Water-level fluctuations due to earth tides are recorded in two of these systems, but these fluctuations are more apparent in the crystalline metamorphic rock system because there are not as many other factors causing water-level fluctuations. No water-level-fluctuation due to earth tides has been observed in wells in the triassic rock because of the very low permeability. The water-level fluctuations due to earth tides in the crystalline rock are about 10 cm. In a one-year pumping test on a well in the crystalline metamorphic rock, the flow was controlled to within 0.1% of the total discharge, which was 14.9 gpm. The water-level fluctuations due to earth tides in the pump-

ing well were 10 cm, the same as when this well was not being pumped. (auth)

21151 (HW-30347) SUMMARY OF COLUMBIA RIVER HYDROGRAPHIC INFORMATION PERTINENT TO HANFORD WORKS, 1894 TO 1954. Wood, V. W. (Hanford Works, Richland, Wash.). 24 Feb 1954. 82p. Dep. NTIS $6.25.

21152 (NERC-LV-539-22) STATUS OF THE ENVIRONMENTAL PROTECTION AGENCY'S NEVADA TEST SITE EXPERIMENTAL DAIRY HERD, JANUARY 1, 1969–DECEMBER 31, 1970. Smith, D. D. (National Environmental Research Center, Las Vegas, Nev. (USA)). Jun 1973. Contract AT(26-1)-539. 62p. Dep. NTIS $5.45.

The status of the dairy herd at the Nevada Test Site for the period January 1, 1969 through December 31, 1970, is described. The report lists changes and improvements made on the facilities; presents herd and individual production and reproduction statistics; details health problems and treatments; and summarizes the metabolism, field, and ad hoc research studies that involved the dairy herd. (CH)

21153 (PNE-RB-47) PROJECT RIO BLANCO: PROMPT ECOLOGICAL EFFECTS RESULTING FROM GROUND MOTION. Whicker, F. W.; Alldredge, A. W.; Hanson, W. C. (CER Geonuclear Corp., Las Vegas, Nev.). 17 Jul 1973. 72p. Dep. NTIS $5.75.

Ecological effects resulting from ground motion observed by field studies and aerial surveying within 24 hours following the Project Rio Blanco underground nuclear explosion to stimulate natural gas production in Colorado are described. Observations were compared with those made in the environs immediately prior to the detonation. The effects described, and a rating system which attempts to place such effects into some quantitative perspective, are summarized. It is clear from the data that ground motion associated with Project Rio Blanco resulted in measurable ecological impacts on both aquatic and terrestrial ecosystems. (CH)

21154 (PRNC-162(App.)) AGUIRRE POWER PROJECT ENVIRONMENTAL STUDIES 1972 ANNUAL REPORT. (Puerto Rico Nuclear Center, San Juan). Mar 1973. Contract AT(40-1)-1833. 213p. Dep. NTIS $12.75.

A separate abstract was prepared for each section of the report. (DHM)

For abstracts of individual sections see: 20673, 20674, 20718, 21155, 21156, 21161–21163, and 24027–24033.

21155 (PRNC-162(App.), pp 258-288) MACROZOOPLANKTON OF JOBOS AND GUAYANILLA BAYS, SOUTHERN PUERTO RICO, AND ITS FLUCTUATIONS UNDER SPECIAL CONDITIONS. Suarez Caabro, J. A.; Shearls, E. A. (Puerto Rico Nuclear Center, San Juan). Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

A survey was made of the species diversity, abundance, and distribution of marine zooplankton of Jobos and Guayanilla Bays. Tables are presented to show data for crustaceans, cnidarians, molluscs, brachiopods, annelids, and protozoans. (HLW)

21156 (PRNC-162(App.), pp 289-303) FORAMINIFERS OF GUAYANILLA BAY. Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

A survey was made of the foraminiferans and nematodes in sediment samples of Guayanilla Bay and their relationship to chemical pollution is considered. Temperatures and salinities of the bay were recorded. The abundance, distribution, and species diversity of the foraminiferans are tabulated. (HLW)

Thermal Effluents

Refer also to abstracts 20861, 21154, 23473, 23474, 23477, and 23478.

21157 (BNWL-CC-1261) ANALYSIS OF THE PHYSICAL FACTORS GOVERNING THE SIZE AND TEMPERATURE GRADIENTS OF HANFORD EFFLUENT PLUMES. Jaske, R. T. (Battelle Pacific Northwest Labs., Richland, Wash.). 20 Jun 1967. Contract AT(45-1)-1830. 15p. Dep. NTIS $3.00.

Data are reviewed from studies on the Hanford thermal effluent plume diffusion from which it was concluded that the use of dye to simulate the discharge of thermally warm effluent appears feasible on a reconnaissance basis at river currents above 2.0 fps provided the investigator is prepared to accept minor deviations from the ideal plume path which results from the stratification of warm discharges in the boundary regions outside the primary turbulent zone. The dye plume within the thermally warmed portions of the river shifts from side to side and is less stable, in general, than the thermal plumes resulting from a single or combination of individual discharges. An empirical equation was successfully developed which can be used to compute the width of the thermally affected zone and the maximum temperature expected on the plume centerline. The equation contains features which are common to the classical solution of the continuous emission concentration equations. (CH)

21158 (DP-MS-72-59) THERMAL LOADING EFFECTS ON BACTERIAL POPULATIONS OF A NONPOLLUTED FLOWING STREAM. Cherry, D. S.; Guthrie, R. K.; Harvey, R. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1973. Contract AT(07-2)-1. 18p. (CONF-7210100-1). Dep. NTIS $3.00.

From American Society of Microbiology regional meeting; Gainesville, Florida, USA (Oct 1972).

The effects of increased temperatures in an aquatic environment on bacterial populations were studied. Total plate counts and nutrient source types of naturally occurring heterotrophic, mesophilic bacteria were determined from a natural stream, three outdoor artificial ponds, and two environmentally controlled artificial streams. The effects of changes in ambient temperature in the natural stream and the ponds were analyzed. Thermal effects indicated that changes in temperature of plus 3 to 4°C above the naturally occurring ambient water temperature allowed for an increase in total counts and diversity of bacterial types. A 10°C increase in water temperature caused an increase in total bacterial counts; however, a reduction in diversity of types was noted. The response to the changes of certain genera and nutritional source types was also analyzed. (auth)

21159 (DP-MS-73-8) TEMPERATURE EFFECTS ON THE SORPTION OF RADIONUCLIDES BY AQUATIC ORGANISMS. Harvey, R. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 20p. (CONF-730505-8). Dep. NTIS $3.00.

From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

The warm waters of the reactor effluent streams within the Savannah River Plant are sufficiently cooled to support diverse populations of aquatic organisms prior to their confluence with the river. Indigenous species of plants and animals are being studied in the laboratory to determine their role in the fate of radionuclides discharged to the freshwater environment. The effects of water temperature changes on the growth of algae, midge larvae, and freshwater shrimp, and their ability to sorb radioactive materials are reported. (auth)

21160 (ORO-2412-47) LOCAL ENVIRONMENTAL EFFECTS OF A NATURAL DRAFT COOLING TOWER PLUME. Tate, A. L. (Emory Univ., Atlanta, Ga.). 1973. Contract AT(40-1)-2412. 108p. Dep. NTIS $7.50.

Thesis.

A field investigation of the local environmental effects of a natural draft cooling tower plume from a fossil-fuel power plant was conducted with emphasis on the potential for biological impact. A network of five stations was constructed at varying distances in a geographical array around the cooling tower. Ecologically similar sites were chosen. Continuous monitoring of temperature, relative humidity, and dew, and weekly accumulation of precipitation (all near ground level) gave no indication of any effects from the cooling tower plume during the nine-month study period. Analysis of experimental data was based on the geographical array of stations and proximity to the tower and took advantage of intermittent power plant operations during the study period. Station profiles during operating and nonoperating days were compared. Data from seven proximal Environmental Data Service Weather Stations for the study period and the previous 12 years (before power plant construction) were also analyzed. No significant impact from the cooling tower was found. The importance of water during moisture stress periods was investigated by tree ring growth analysis of exposed loblolly pines as compared with growth rate during the eight year period preceding the study. The possibilities of biological impact resulting from cooling tower thermal effluents are discussed. (CH)

21161 (PRNC-162(App.), pp 304-319) STUDY OF THE EFFECT OF HEATED WATER ON TURTLE GRASS, THALASSIA TESTUDINUM KONIG, IN GUAYANILLA BAY. Schroeder, P. Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

Five stations were established in various turtle grass flats and samples were taken with a specially constructed sampler. Dry weights of various parts of the Thalassia plant were recorded as

well as total weight of plant material. A transplant experiment is described for determining the effects of thermal discharge on Thalassia plants. It is hoped that the experiment will lead to a determination of maximum temperature at which Thalassia communities can exist. (HLW)

21162 (PRNC-162(App.), pp 320-364) MANGROVE ROOT COMMUNITIES IN A THERMALLY ALTERED AREA IN GUAYANILLA BAY. Kolehmainen, S.; Morgan, T.; Castro, R. Mar 1973.

In Aguirre power project environmental studies 1972 annual report.

The effects of elevated temperatures on plankton, benthic organisms, turtle grass beds, mangrove root communities, and fishes were studied in their natural environment. Collections of organisms were made at eight stations in the vicinity of the fossil fuel power plant site. Results showed that neither the species composition nor the biomass of mangrove root communities were affected adversely by temperatures below 34°C. Between 34 and 35°C the number of species dropped abruptly and above this temperature the number of species was inversely related to the temperature of the water. (HLW)

21163 (PRNC-162(App.), pp 446-464) MATHEMATICAL SIMULATION OF THERMAL PLUMES. Mar 1983.

In Aguirre power project environmental studies 1972 annual report.

Part one consists of a reexamination Section III-D-1-b (The Plant-Effluent Systems-Heat-Environmental Influences, pp 64-65) of the Aguirre Power Plant Complex Environmental Report. The second part contains calculations, parametric studies and a modification of the basic Pritchard model intended to provide a quantitative basis for the evaluation of the applicability of the model to conditions existing in the Aguirre Ship Channel, and to examine the effect of reentrainment on the predicted plume extent. Specifically this part consists of an outline of the basic model equations, a comparison of required entrainment flow to ambient flow, the effect of entrainment of heated water on the size of the 4°F isotherm and the effect of deflection and subsequent re-entrainment of heated water impinging on the Cayos on its temperature. All calculations are for the case of two fossil plants. (auth)

21164 COOLING POND TEMPERATURE VERSUS SIZE AND WATER LOSS. Tichenor, B. A.; Christianson, A. G. J. Power Div., Amer. Soc. Civil Eng.; 97: 589-596(Jul 1971).

Analyses of loss mechanisms show that for a given heat loss, evaporative loss may be reduced by discharging hotter water to the pond and using smaller ponds. Hotter discharge means a less efficient power plant, but in arid or semi-arid climates, water savings may offset this economically. Calculations for a 1000 Mw_e nuclear plant based on meteorological data for Dallas, Texas, in the summer showed that predicted evaporative loss could be reduced from 50 to 36 cubic feet per second by raising water temperatures 10°F (i.e., 125°F vs 115°F for discharge) and using an 800 acre pond in place of an 1800 acre one. Two very small ponds, 8 feet in diameter, were field tested in south-central Oregon and supported the calculations. Unfortunately the heat load on one of the test ponds was negligible, so the results are hardly conclusive. (App. Mech. Rev.)

21165 THERMAL LOAD OF THE ENVIRONMENT BY HEAT PROCESSES. Schaefer, H. (Technische Univ., Munich). (1973). vp. (In German).

From meeting of electrothermics; Duesseldorf, Germany (30 Jan 1973).

The energy content of all primary energy carriers on earth is finally released as waste heat which can be neglected in the earth's énergy budget. Today, in densely populated areas, the thermal load due to the energy conversion is about 20% of the sun's energy in that area. It is expected that the further increases in energy required will have unfavorable effects on the local climate of these densely populated areas, thus a most rational possible application of energy, in particular concerning heat requirements (approximately two thirds of the energy requirements) is called for. The electrical methods regarding thermal loading at the place of application are superior to other methods for the heating of building and the generation process heat. In very crowded areas, a much greater move will be made than in the past to make use of all waste heat and to lower the specific need. (GE)

Chemical Effluents

Refer also to abstracts 20667, 21057, 21064, 21065, 21073, 21654, 21800, 23901, and 23902.

21166 (BNL-50361) ATMOSPHERIC DIAGNOSTICS PROGRAM AT BROOKHAVEN NATIONAL LABORATORY: FOURTH STATUS REPORT. Tucker, W. D. (ed.). (Brookhaven National Lab., Upton, N. Y.). Jun 1972. Contract AT(30-1)-16. 54p. Dep. NTIS $5.45.

Work has continued on the development of tracer methods for use in atmospheric pollutant studies and their application to large-scale problems in the field. The isotope ratio tracer method was used to follow the oxidation of SO_2 in plumes from coal-burning power plants. The rate of conversion of SO_2 to sulfate was found to be considerably lower than in the plume of an oil-fired plant. Some evidence was found for sulfate falling out of the plume near the stack. Sulfur isotope ratio measurements were also used to indicate the source of sulfur-bearing particulates in the stratospheric Junge layer. Development of an isotope ratio tracer method for nitrogen oxides, based on the $^{14}N/^{15}N$ ratio, is also being pursued. A portable, real-time, gas-chromatographic detector was developed and used to trace sulfur hexafluoride injected into a power-plant stack, both aloft and on the ground. A detection limit of $<10^{-12}$ parts of SF_6 per part of air is achieved routinely. Plume profiles determined by SF_6 tracing and by the optical densitometer are in good agreement, but the SF_6 method is much more sensitive. Plume dispersion measurements with SF_6 were made well beyond 100 km from the source. The effect of wind shear on plume structure was noted. Errors inherent in establishing plume dispersion parameters on the basis of single-pass measurements in the plume are indicated. The method for the collection of sulfate particulates in the atmosphere has been improved and a procedure is described for distinguishing between H_2SO_4, $(NH_4)_2SO_4$, and other sulfates and and bisulfates in the small samples of particulates collected. (auth)

21167 (BNWL-1751(Pt.1), pp 65-67) STUDIES OF WASHOUT FROM THE PLUME OF A COAL-FIRED POWER PLANT. Dana, M. T.; Hales, J. M.; Wolf, M. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Washout of sulfur compounds from the plume of the Centralia power plant was studied experimentally. In this study precipitation was collected at various locations beneath the plume and analyzed chemically for SO_2, hydrogen ion, and $SO_4^=$. Five field tests were completed during this series of experiments. (auth)

21168 (BNWL-1751(Pt.1), pp 68-72) REDISTRIBUTION OF A GAS PLUME CAUSED BY REVERSIBLE WASHOUT. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

An analytical study was made of the influence on a gas plume of reversible scavenging by rain. The result predicts that at large time, a plume will be washed downward at a rate $H'J_0$, where J_0 is the rainfall rate and H' is the dimensionless Henry's law constant. Results are shown for the specific case of an SO_2 plume. (auth)

21169 (BNWL-1751(Pt.1), pp 72-75) SNOW SCAVENGING OF LEAD PARTICULATES. Lee, R. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A short field study has been conducted to evaluate the effectiveness of snow scavenging for the removal of lead aerosols generated by automotive exhaust. This study employed a grid network of snow samplers in the vicinity of a highway, with subsequent analysis of the collected snow for lead using an atomic absorption technique. The results indicate that under appropriate conditions snow is an effective scavenger of particles of this type. (auth)

21170 (BNWL-1751(Pt.1), pp 76-79) TRACER STUDY OF IN-CLOUD SCAVENGING BY FRONTAL STORMS. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A report is given of progress made in the field program designed to determine the influence of pertinent parameters on the in-cloud scavenging of tracer particles by frontal storms. Applications to studies of snow scavenging of lead aerosols are discussed briefly. (CH)

21171 (BNWL-1751(Pt.1), pp 93-97) PRECIPITATION SCAVENGING OF INORGANIC POLLUTANTS FROM METROPOLITAN SOURCES. Dana, M. T.; Hales, J. M.; Thorp, J. M. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the

USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Rainwater samples from convective storms in the St. Louis metropolitan area were collected and analyzed for the chemical species SO_2, NO_3^-, NH_4^+, NO_2^-, SO_4^{2-}, and H^+. Preliminary results indicate significant washout of these city-produced pollutants often occurs within a few miles of the down-storm side of the city. (auth)

21172 (BNWL-1751(Pt.1), pp 98-100) TRACER STUDIES OF CONVECTIVE STORMS IN THE METROPOLITAN METEOROLOGICAL EXPERIMENT. Young, J. A.; Tanner, T. M.; Thomas, C. W.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The Metropolitan Meteorological Experiment (METROMEX) is a study of convective storms in the St. Louis area. Scientists from the Radiological Chemistry Section conducted two main experiments during METROMEX in 1972. The first was the sequential release of six inert tracers from 10 to 13.5 thousand feet near the upwind edge of convective towers to measure the amount of air entrained, which reached regions of precipitation scavenging. Samples of rain from these convective storms were collected using a network of 122 samplers. They are now being analyzed by neutron activation for the tracers and for other elements to determine scavenging efficiencies and tracer trajectories. In the samples analyzed, those collected 10 to 20 miles downwind of the gold, iridium, and tantalum releases, measurable quantities of these tracers were generally present. The second experiment was the measurement of the trace element composition of air filter samples to determine the contribution of the St. Louis metropolitan area to the contamination of the atmosphere. (auth)

21173 (BNWL-1751(Pt.1), pp 104-106) SIZE DISTRIBUTIONS OF ST. LOUIS AEROSOL PARTICLES. Alkezweeny, A. J. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The size distributions of aerosol particles were measured during the month of August, 1972, in St. Louis. The result shows that for a day with low-level temperature inversion, the size distribution is characterized by high concentrations of larger particles. The size distribution averaged over the entire period of measurement approximately fit the equation $\Delta N/\Delta D = 6.5D^{-4}$. (auth)

21174 (BNWL-1751(Pt.1), pp 107-108) RESIDENCE TIME OF PARTICLES IN URBAN AIR. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

A critique is made of recent discussions in the literature about the relationship between turbidity variations and the residence time of particles in an urban atmosphere. (auth)

21175 (BNWL-1751(Pt.1), pp 109-112) CONCENTRATIONS OF AEROSOL AND TRACE GASES OVER ST. LOUIS. Alkezweeny, A. J. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Two aircraft flights were made over St. Louis to determine the vertical and horizontal distributions of aerosol particles, SO_2, and ice nuclei. It was found that under calm wind conditions the aerosol concentrations were nearly invariant with altitude, but a considerable variation across the city occurs. The SO_2 concentration was in the range between 0.3 to 0.6 ppM. High concentrations of ice nuclei active at −20°C were observed. (auth)

21176 (BNWL-1751(Pt.1), pp 135-137) MEASUREMENTS OF ATMOSPHERIC AEROSOL PARTICLES. Slinn, W. G. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Results are shown for number and volume distributions, in the diameter range from 0.3 to 8 μm, of atmospheric aerosol particles measured at ground level sites in the Blue Mountains, Oregon; Monterey Bay, California; Basalt, Colorado, and Edwardsville, Illinois. (auth)

21177 (BNWL-1751(Pt.1), pp 138-140) COMPARISON OF THE PARTICULATE POLLUTANT LEVELS AT PROPOSED BASELINE MONITORING STATIONS. Ludwick, J. D.; Young, J. A.; Rancitelli, L. A.; Davis, W. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

It is important that one or more sophisticated atmospheric "baseline" monitoring stations be established at locations where there is a minimum of interference from local sources in order to: assess the biological cost of environmental pollution increases from industrial and nuclear operations; to determine the effectiveness of control measures; to assist in identifying contributions from a particular source; and to provide data for establishing an acceptable environmental pollutant level among nations. The site selected should be free from local pollution so comparable measurements can be expected for years to come. Our purpose is to find, instrument, and operate a survey station at such a location. At this station, the spectrum of radionuclides and inorganic and organic pollutants will be studied as a function of time and of local and hemispheric meteorological parameters. (auth)

21178 (BNWL-1751(Pt.1), pp 144-148) MODEL FOR NEAR SURFACE COMPUTATION OF MONTGOMERY STREAM FUNCTIONS. Davis, W. E. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Macroscale trajectory techniques are being used to predict air-mass transport in conjunction with analyses of particle deposition, resuspension, and scavenging. A model was developed to compute Montgomery stream functions from bilinear interpolated soundings from four radiosonde sites. The results of comparing the model sounding with observed sounding indicates that within a standard deviation of $\pm 0.05 \times 10^7$ cm^2 sec^{-2} accurate stream functions could be computed over a range of 1000 mb to ~925 mb. Implications of these results as well as proposed future work are included. (auth)

21179 (UCID-16301) DEVELOPMENT OF AN AIR POLLUTION MODEL FOR THE SAN FRANCISCO BAY AREA. First Semiannual Report to the National Science Foundation. Feldstein, M.; MacCracken, M. C.; Reinisch, R. F. (California Univ., Livermore. Lawrence Livermore Lab.). 9 Jul 1973. Contract W-7405-eng-48. 140p. Dep. NTIS $9.00.

Criteria are presented for the development of an air pollution model for the nine-county San Francisco Bay Area, California. Topics discussed include the choice of monitoring instruments, computer data acquisition and storage systems, and the correlation of meteorological data and air quality measurements. Applications of the model during short-term conditions of increased pollutant emission and for the prediction of annual pollutant concentrations and for land use planning are discussed. (CH)

21180 ATMOSPHERIC SULFUR DIOXIDE AND SULFATE: DISTRIBUTION OF CONCENTRATION AT URBAN AND NONURBAN SITES IN UNITED STATES. Altshuller, A. P. (National Environmental Research Center, Research Triangle Park, NC). Environ. Sci. Technol.; 7: No. 8, 709-712(Aug 1973).

The interpretation of results from the U. S. National Air Surveillance Networks indicates that large differences in sulfate concentration levels exist between eastern and western urban and nonurban sites in the United States. Sulfates contribute a larger portion of the sulfur compounds at western urban sites than at eastern urban sites. The relationship of sulfur dioxide to sulfate is nonlinear over the range of concentrations at urban sites. Statistical relationships were computed relating urban sulfate to urban sulfur dioxide and also to the ratio of sulfur dioxide to sulfate. Background levels of water-soluble sulfate differ greatly between the eastern and western U. S. At the eastern nonurban sites, a residue sulfate level of at least 5 μg/m^3 exists. This large residue is attributed to long-distance transport of sulfur dioxide with conversion of urban sulfur dioxide to sulfate during transport. Sulfate-containing aerosols are broadly distributed throughout large regions of the eastern and midwestern U. S. (auth)

21181 STACK HEIGHT REQUIREMENTS IMPLICIT IN THE FEDERAL STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES. Lee, W. L.; Stern, A. C. (Univ. of North Carolina, Chapel Hill). J. Air Pollut. Contr. Ass.; 23:. No. 6, 505-513(Jun 1973).

On April 30, 1971, the Environmental Protection Agency (EPA) promulgated primary and secondary national air quality standards for particulate matter, sulfur oxides, and nitrogen dioxides, and on December 23, 1971, EPA promulgated emission standards for the emission of these three pollutants from new fossil-fuel fired steam generating plants, of particulate matter from new Portland cement plants and new incinerators, of sulfur oxides from new sulfuric acid plants, and of nitrogen oxides from new nitric acid plants. If one of the foregoing types of new plants were to be the only source of the regulated pollutant in a region its stack should be sufficiently high that when its emission is at the maximum permissible limit, the secondary air quality standard should not

be exceeded at any point in the region. By selecting an appropriate stack plume dispersion formula and proper input parameters for use therein, a computation can be made for the stack height required. The determination of minimum stack height is complicated by the fact that the performance and air quality standards are stated on different averaging time bases; that the extent of preemption of the assimilative capacity of the air by any individual source will vary among jurisdictions and, in some cases, among different geographic areas of a single jurisdiction; and that some new sources will be designed to emit appreciably less than the performance standard requirement. However, these complications can be resolved and equations and charts prepared from which minimum stack height can be selected. (CH)

21182 APPLICATION OF COMPUTER CONTROLLED HIGH RESOLUTION MASS SPECTROMETRY TO THE ANALYSIS OF AIR POLLUTANTS. Schuetzle, D.; Crittenden, A. L.; Charlson, R. J. (Univ. of Washington, Seattle). J. Air Pollut. Contr. Ass.; 23: No. 8, 704-709(Aug 1973).

An AEI-MS9 high resolution mass spectrometer interfaced with a PDP-12 digital computer was adapted for the multicomponent analysis of air pollutants. Air sampling techniques for particulate and gaseous pollutants that are compatible with the mass spectrometric system were developed. A single stage impactor was designed for sampling particulate matter of particle diameters greater than 1 to 2 μm. The remainder of the particulate matter is collected on a glass fiber filter. Gaseous pollutants are collected on a styrene–divinylbenzene copolymer (Chromosorb 102). The particulate samples are introduced directly into the mass spectrometer utilizing a temperature programed insertion probe. Gaseous pollutants are desorbed from the copolymer directly into the mass spectrometer by heating. Analysis of composite mass spectral data is facilitated through the use of a digital computer utilizing newly developed computer programs. Final computer output yields qualitative and quantitative results for up to 300 pollutants. Organic pollutants identified in particulate matter include polycyclic aromatic compounds, alkyl chlorides, polychlorinated aromatics, substituted benzenes, and organic acids. Composite quantitative results are reported for alkanes and alkenes in the following groups: $C_{15}-C_{30}$, $C_{20}-C_{50}$ and $C_{50}-$ polymeric. Inorganic pollutants identified include As_4O_6, H_2SO_4, $(NH_4)_2SO_4$, $(NH_4)_2SO_3$, $NaHSO_4$, NH_4NO_3, $NaNO_3$, NH_4Cl, SeO_2, I_2, elemental sulfur, and elemental cadmium. (auth)

21183 COAGULATION INVOLVING MOLECULE-SIZE NUCLEI. Storeboe, P. B. (Forsvarets Forskningsinstitutt, Kjeller, Norway). J. Aerosol Sci.; 4: No. 4, 337-338(Jul 1973).

Coagulation between nuclei from chemical trace gas reactions in air is discussed by Walter (J. Aerosol Science; 4(1): 1-15(1973)). His choice of a mean nucleus size $r = 1.2 \cdot 10^{-7}$ cm for use in the coagulation equation is considered, and a model for the early coagulation phase is proposed. (auth)

21184 VOLUMETRIC METHODS FOR CONTROL OF AMMONIA SCRUBBING PROCESS FOR REMOVAL OF SO_2 FROM STACK GASES. Woodis, T. C. Jr.; Cummings, J. M. Jr.; Hunter, G. B. (Tennessee Valley Authority, Muscle Shoals, AL). Environ. Sci. Technol.; 7: No. 9, 827-828(Sep 1973).

Volumetric methods for analytical control of the ammonia scrubbing process were developed from standard analytical procedures. Results of three titrations are sufficient to calculate the concentrations of ammonium bisulfite, sulfite, and sulfate in the scrubber liquor before or after the liquor is acidified with ammonium bisulfate and stripped of its SO_2. Two titrations are sufficient to determine the composition of the ammonium bisulfate that is used to strip the scrubber liquor. The only interfering ion is chloride, which is determined by titration with silver nitrate. A suitable correction is applied. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 21071, 21809, 22139, 22165, 22209, 22227, 22234, 22960, 22964, 23155, 23411, 23412, 23486, and 23639.

21185 (AAEC/LIB/Bib-368) DETECTION OF FISSION FRAGMENTS BY TRACK-ETCH TECHNIQUE. A Bibliography. Newland, E. A. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1972. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

Two hundred and forty-four references are given chronologically by year covering the period from 1961 to 72. Each year is arranged alphabetically by author. Reference is made to abstracts for citations in NSA. (AT)

21186 (AD-756826) USE AND PROCESSING OF NUCLEAR EMULSIONS AS PARTICLE DETECTORS. Fukui, K. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 12 Oct 1972. 128p. (AFCRL-72-613; AFCRL-IP-180). NTIS.

The paper was written primarily for the technicians who handle nuclear emulsions. It covers some of the fundamental techniques for the daily use of nuclear emulsion in the laboratory. Although some newly developed methods are included, most effort was devoted to giving further detail on already established methods. Techniques for preparing the emulsion sample, exposing the emulsion to radiation, processing the emulsion, photomicrography, scanning and measuring are described in simple language. (auth)

21187 (AD-760313) DATA PROCESSING SYSTEM FOR THE STANDARDIZATION OF A NEUTRON CALIBRATOR. Brown, B.; Summerer, R. W. (Naval Ordnance Lab., White Oak, MD). 15 Mar 1973. 35p. (NOLTR-73-57). NTIS.

A computerized Data Processing System has been developed which processes, analyzes, and reports field data taken in the standardization of the AN/UDM-5 shipboard neutron calibrator that is used to calibrate a neutron detecting Radiac Set, the AN/PDR-70. The system processes data taken from a set of transfer standard instruments and calculates the dose rate for each measurement and also the averages and standard deviations of each set of measurements. A series of tables are printed listing the dose rates obtainable from the calibrator. The tables are dated and corrected for neutron source activity buildup. (auth)

21188 (CEA-CONF-2278) ELECTROMETER DEVICE FOR THE AUTOMATIC MEASUREMENT OF SMALL CURRENTS FROM STANDARD IONIZATION CHAMBERS. Roulet, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 30 May 1972. 25p. (In French). (CONF-720567-3). Dep. NTIS (U. S. Sales Only) $3.25.

From 7th national congress on the monitoring of ionizing radiations conference; Marseilles, France (16 May 1972).

An experimental electrometer device is described that enables currents of less than 10^{-13} A to be measured with an overall reproductibility (source-detector-measuring unit) of better than 5.10^{-3}. The utilization of a secondary standard in conjunction with this equipment enables dosimeters to be calibrated by comparison. The systematic error affecting the measurement of the current is a function of the integrated capacitance. An accuracy of 5.10^{-3} is currently achievable for currents $\geq = 10^{-12}$ A and an accuracy of the order of 1% obtainable for currents of between 10^{-15} and 10^{-12} A. In the case of current measurements of less than 10^{-13} A and the utilization of a capacitance of 2.10^{11} Farads, the input capacitance of the coaxial chamber cannot be neglected if an accuracy of better than 1% is required. A correction must thus be applied to the value of the capacitor considered. The absolute accuracy of the measurement unit is difficult to assess with an accuracy of better than 1% owing to the unavailability of a sufficiently accurate and time stable current source. An overall calibration with a transfer chamber will be affected using national standards. (FR)

21189 (CEA-R-4458) HANDLING OF ROUTINE MONITORING OF RADIOACTIVE CONTAMINATION BY IN VIVO MEASUREMENTS. Daburon, M. L.; Jeanmaire, L. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1973. 33p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

The theoretical and practical thresholds of detection of γ-emitters with an energy range between 100 and 1500 keV were determined from the data supplied by ICRP Publications 2 and 10 for a particular whole-body counter. The method that should be used with fairly different counters is also indicated. (auth)

21190 (CONF-730819-2) NEUTRON-FLUX MEASUREMENTS USING MONITOR PAIRS. Papastergiou, C.; Swanks, J. H. (Oak Ridge National Lab., Tenn.). 1972. 23p. Dep. NTIS $3.25.

From conference on reactor operating experience; Myrtle Beach, South Carolina, USA (5 Aug 1973).

A method for measuring absolute thermal-neutron and epithermal-neutron fluxes in a mixed neutron spectrum environment without using cadmium or similar thermal-neutron filters is described. The method uses pairs of neutron flux monitors which have appropriate nuclear characteristics. One monitor of the pair should have a nearly 1/v neutron cross section in the thermal region and the other should have a resonance integral that is large compared to its thermal neutron cross section. To verify the method, the thermal and epithermal neutron fluxes were measured with this technique in an irradiation facility in the High Flux Isotope Reactor (HFIR). For these tests cobalt, silver, manganese and gold were used. These materials were chosen because their nuclear characteristics, which in most cases are reasonably well-known, fit the requirements of the two-foil method. Manganese and gold have relatively short half-lives which make them appropriate for short-term irradiations such as might be appropriate for low-power flexibly-operated research reactors; cobalt and silver have long half-lives which make them appropriate for long-term, high power, fixed operating cycle irradiation facilities in higher power research and power reactors. Thus, the two pairs illustrate the use of the method for a range of irradiation conditions. (auth)

21191 (FMI-1000-421) USE OF LIQUID XENON SCINTILLATOR FOR DETECTING PHOTONS AT AND BELOW 500 keV. Lavoie, L. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1971. 17p. (CONF-710726-2). Dep. NTIS $3.00.

From 13th annual meeting of the American Association of Physicists in Medicine; Houston, Texas, USA (6 Jul 1971).

The physical properties of liquid xenon are summarized, and the detector properties of liquid xenon are compared to those ot NaI(Tl). Preliminary tests on liquid xenon scintillators are discussed and plans to develop a positron scanner are given. (WHK)

21192 (FMI-1000-429) POSITRON DETECTION SYSTEM USING LIQUID XENON SCINTILLATOR. Lavoie, L. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1971. 11p. (CONF-710605-2). Dep. NTIS $3.00.

From 18th annual meeting on society of nuclear medicine; Los Angeles, California, USA (28 Jun 1971).

Properties of liquid xenon scintillators are discussed and compared to NaI(Tl) scintillators for use in positron imaging systems. Plans for a positron scanner using liquid xenon scintillation detectors are discussed. (WHK)

21193 (FMI-1000-451) USE OF INERT ELEMENT SCINTILLATORS IN NUCLEAR MEDICINE. Lavoie, L. 1973. 22p. (CONF-730541-2). Dep. NTIS $3.25.

From symposium on advanced technology arising from particle physics research; Argonne, Illinois, USA (17 May 1973).

A review on the properties, instrumentation, and uses of inert element scintillators in diagnostic nuclear medicine is given. Liquid helium scintillators for neutron radiography, gas or liquid xenon scintillators for proton radiography, and liquid xenon scintillators for radioisotope scanners and gamma cameras are discussed. Design considerations for the optical system, the cryogenic system, and photomultiplier and electronics system are briefly discussed. (53 references) (WHK)

21194 (FMI-1000-452) USE OF CHERENKOV RADIATION DETECTORS FOR MEDICAL PHYSICS APPLICATIONS BELOW 1 MeV. Lavoie, L. 1972. 8p. (CONF-721229-1). Dep. NTIS $3.00.

From American Association of Physicists in Medicine meeting; Chicago, Illinois, USA (Dec 1972).

The possible use of Cherenkov radiation detectors for positron imaging in nuclear medicine is discussed. (WHK)

21195 (JPRS-59478, pp 17-43) FLUX MEASUREMENT OF 0.01- TO 18-MeV MONOENERGETIC FAST NEUTRONS. Kung, L. H.; Liu, C. 10 Jul 1973. Translated from Wu-li; 1: No. 2, 62-78(Oct 1972).

Flux measurements of 0.01 to 18 MeV monoenergetic fast neutrons are carried out using four different methods in accordance with four energy regions. From 0.01 to 0.1 MeV, the ^{7}Be radiation

method is used; from 0.1 to 1.5 MeV, the hydrogen proportional counter is used; from 1.0 to 5.0 MeV, the semiconductor recoil counter and telescope are used; and from 5.0 to 18 MeV, the scintillation telescope is used. In order to test the reliability of each method, the results obtained from two different methods at the same energy point are compared. At 14 MeV, the associated-particle method is used for comparison, at 880 keV and 220 keV, the results are checked against the Na–Be and Na–D_2O sources. Comparisons show that the results agree with each other within 5%. To facilitate usage, the efficiency of a long counter has been calibrated for the range of neutron energies E_n = 0.01 to 5.0 MeV. The theory and experimental techniques of the above four methods are described, and an analysis of the measurement errors is presented. (JPRS)

21196 (KAPL-P-4005) FAST NEUTRON FLUX MEASUREMENT. Kirouac, G. J.; Eiland, H. M.; Slavik, C. J. (Knolls Atomic Power Lab., Schenectady, N. Y.). 1973. Contract W-31-109-eng-52. 13p. (CONF-730910-5). Dep. NTIS $3.00.

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973).

The characteristics of ten different threshold reactions useful for fast-neutron flux or fluence measurements are discussed. The ^{252}Cf fission spectrum average cross sections were measured for these reactions and are compared with the corresponding values computed from a library of differential data. Preliminary results for the fission yields of several radioactive ^{237}Np fission products are also presented, and a more detailed experiment is outlined. Finally, a technique for unfolding fast neutron spectra from measured reaction integrals is discussed, and results are shown for the ^{252}Cf fission spectrum. (auth)

21197 (LBL-1666, pp 365-366) PROTON POLARIMETER OF HIGH EFFICIENCY AND GOOD ENERGY RESOLUTION. Birchall, J.; Dahme, W.; Arvieux, J.; Larimer, R. M.; Conzett, H. E. May 1973.

In nuclear chemistry annual report, 1972.

21198 (LBL-1666, pp 366-368) PARTICLE-IDENTIFYING FOCAL PLANE DETECTOR. Harvey, B. G.; Homeyer, H.; Mahoney, J.; Gabor, G. May 1973.

In nuclear chemistry annual report, 1972.

21199 (LBL-1666, pp 378-379) 100 psec PULSE-WIDTH DISCRIMINATOR. Bowman, J. D.; Poskanzer, A. M.; Landis, D. May 1973.

In nuclear chemistry annual report, 1972.

21200 (MLM-2048(OP)) APPLICATION OF PHOSWICH DETECTORS FOR LUNG COUNTING PLUTONIUM-238. Tomlinson, K. F.; Brown, R.; Anderson, H.; Robinson, B. (Mound Lab., Miamisburg, Ohio). [nd]. Contract AT-33-1-Gen-53. 6p. (CONF-730907-8). Dep. NTIS $3.00.

From 3rd international congress on the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Mound Laboratory's Whole Body Counter was designed and calibrated for the detection of ^{238}Pu in the lungs. The basic counting program since December 1969 is summarized. The primary discussion is centered around the phoswich detection system. A unique triple coincidence pulse shape discrimination technique was used to reduce the background more than one order of magnitude as compared to a standard NaI(Tl) detector. Detection limits are given as a function of the subject's tissue thickness between the lungs and detectors. For a typical subject with an effective tissue thickness of 2.3 cm over the lungs, the system has a detection limit of 4 nCi. (auth)

21201 (MUP-3408-34) SCINTILLATION PROCESS IN INORGANIC PHOSPHORS. Final Report. Van Sciver, W. J. (Lehigh Univ., Bethlehem, PA. Office of Research). 4 Jun 1973. Contract AT(11-1)-3309. 11p. Dep. NTIS $3.00.

Seven years of research is briefly summarized. Topics included the thallium dimer center, energy transfer between dimer and monomer, copper centers in NaI single crystals, the properties of exciton states in NaI, photoconductivity in NaI, optical properties of LiI, and ionic and ionic thermal conductivity of NaI. (WHK)

21202 (RL-73-53) TRACK SENSITIVE TARGETS AND RAPID CYCLING BUBBLE CHAMBERS. Fisher, C. M. (Rutherford High Energy Lab., Chilton (England)). Jun 1973. 41p. (CONF-730531-8). Dep. NTIS (U. S. Sales Only) $4.25.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

Conventional hydrogen/deuterium chambers suffer from two limitations, (a) lack of effective π^0 meson detection because of the long conversion length for gamma rays and (b) the data rate is extremely low and nonselective. To overcome these limitations the development of the track sensitive target, which is a region of liquid hydrogen or deuterium contained within a neon-hydrogen chamber which provides isotropic gamma detection, and the rapid cycling chamber which provides high data rates and can be selectively triggered for specific reactions or classes of reactions is reviewed. (UK)

21203 (RL-73-55) SOME PROPERTIES OF THE RHEL 20 CM × 20 CM × 2MM MWPC's. Bateman, J. E. (Rutherford High Energy Lab., Chilton (England)). 15 May 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

The results of laboratory techniques to test multiwire proportional chambers (MWPC), check the specifications of the electronic circuits of the data processing equipment and understand the physics of the chambers are presented. It is shown that the chambers can give acceptable performance with regard to efficiency but fairly severe rate effects have been observed and will require further study. RF pickup would also be a limitation. It is clear that proportional chambers are unlikely to reach the stage of development of scintillation counters. MWPCs would always be tricky to handle and would require well stabilized gas mixtures and sensible control of the radiation intensities to which they are subjected. (UK)

21204 (STI/PUB-315(Vol. 1)) MEDICAL RADIOISOTOPE SCINTIGRAPHY, 1972. Vol. I. Proceedings Series. Proceedings of a Symposium Held in Monte Carlo, 23-28 October 1972. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 754p. (In English and French). (CONF-721017–(Vol. 1)). IAEA $28.00.

Separate abstracts were prepared for the 43 papers presented. (WDK)

For abstracts of individual papers see: 21216–21258.

21205 (UCID-16312) ENHANCEMENT OF THE 14-MeV NEUTRON SENSITIVITY OF SOLID STATE DETECTORS. Barton, J. K. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Sep 1973. Contract W-7405-Eng-48. 18p. Dep. NTIS $3.00.

The enhancement of the 14-MeV neutron sensitivity of silicon detectors was experimentally measured and calculated when both hydrogenous and fission foils were placed in front of the detectors. Both the foils and detectors were designed in conjunction with diagnostic requirements at NTS to give the best possible sensitivity enhancement. Experimental results showed that the neutron sensitivity is not appreciably enhanced by the addition of either hydrogenous or fission foils. The hydrogenous foil enhanced the sensitivity by a factor of 1.6 while the fission foil produced no noticeable enhancement within the experimental error. Calculations agreed with experimental results within 30%. (auth)

21206 PULSE ACTIVATION: A METHOD FOR INVESTIGATION OF SHORT-LIVED NUCLEAR STATES. Brinckmann, H. F.; Heiser, C. (Zentralinstitut fuer Kernforschung, Berlin). Exp. Tech. Phys.; 21: No. 1, 1-14(1973). (In German).

In the last ten years the pulse activation method has been developed to a powerful tool for investigations of nuclear states with short lifetimes. In this method a target is irradiated by short beam pulses and the induced activities are measured in the pauses between the beam bursts. Different arrangements used for beam pulsing are summarized. An example for a detector system and for a multi-parameter registration device is described. The success of the pulse activation method is demonstrated by some selected topics containing investigations on nuclear isomerism and discussions of nuclear structure problems. (auth)

21207 STATISTICAL ACCURACY OF COUNTS MADE ON AUTOMATIC RADIOACTIVE SAMPLE CHANGEOVER DEVICES: CONSTRUCTION OF A PRECOUNT-PRESET SERIES OF CURVES. Assailly, J.; Bader, C.; Pavel, D.; Chanard, J.; Funck-Brentano, J. L. (Institut National de la Sante et de la Recherche Medicale, Paris). Ann. Phys. Biol. Med.; 6: No. 4, 187-195(1972). (In French).

A system of curves for determining the statistical accuracy of radiation counts made on automatic radioactive sample changeover devices operating on a precounter preset time basis was studied. These curves enable the precount or preset time conditions corresponding to a given degree of precision to be determined for all the series of samples. It is also possible to calculate the statistical accuracy corresponding to each sample in terms of the counting time necessary for a given precount. An example of the way in which these curves can be used to reduce the counting times for a series of samples having different activities is presented. (FR)

21208 NEUTRON FLUX INTEGRATOR. Kulikov, Yu. K.; Dergachev, Yu. T.; Voronkov, G. Ya.; Sunchugashev, M. A.;

Fursov, V. V. At. Energ. (USSR); 34: No. 5, 396-397(May 1973). (In Russian).

A device for integrating the neutron flux of a reactor was designed. It consisted of a self-powered detector connected by a cable to a Hg capillary coulometer–integrator. The integral neutron flux was measured without removing the detector from the core and with a cessation of the radiation. The self-powered detector contained a 300 mm Rh emitter and was placed in the reactor channel. The Hg coulometer–integrator consisted of a glass capillary holding two columns of Hg separated by a gap of electrolyte. Electric leads were connected to the ends of the capillary. Use of the assembly is described. The substitution of V for Rh is advisable for measurements of long duration because of the slower "burn-up" of V. (1 figure) (KSW)

21209 IONOGRAPHY: EMULSIONS AND SOLID STATE DETECTORS. Avan, L.; Avan, M.; Blanc, D.; Teyssier, J. L. Paris; Doin (1973). 347p. (In French).

The chapter headings are as follows: ionization induced by charged particles; utilization of ionographic emulsions in particle physics, latent images; nuclear emulsions; general scattering theory; application of nuclear emulsions; solid state track detectors (formation of the latent image); solid track detectors (chemical development of the latent track and the obtaining of data); mechanism by which the tracks are obtained; and practical applications of solid track detectors. (FR)

21210 SEMICONDUCTOR ARRANGEMENT FOR MEASURING IONIZING RADIATION. Goldbach, G. (to Telefunken Patentverwertung GmbH). German Patent 1,812,127. 11 Jun 1970. Filed date 2 Dec 1968. (In German).

The installation of semiconductors for measuring ionizing radiations is described in which at least two bodies of semiconductors at the junctions with large surfaces and rectifying the alternating currents are provided and arranged in the direction of the radiation to be measured in such a way that this radiation meets successively the bodies of the semiconductors transversally with respect to the junctions rectifying the alternating currents. The bodies of the semiconductors are electrically connected in such a fashion that the signals produced are additive as concerns their effect. (TSS)

21211 POSITION-SENSITIVE CHARGED PARTICLE DETECTOR FOR A MINIATURE MATTAUCH-HERZOG MASS SPECTROMETER. Carrico, J. P.; Johnson, M. C.; Somer, T. A. (Bendix Research Labs., Southfield, MI). J. Mass Spectrom. Ion Phys.; 11: No. 4, 409-415(Jun 1973).

A position-sensitive detector for detection of low-energy charged particles is described. The detector is a channel electron multiplier array with a linear resistive anode. Experiments, in which the relative position between the detector and a collimated ultraviolet beam was changed, showed the spatial resolution to be a few tenths of a millimeter. The results are applied to a miniature Mattauch-Herzog mass spectrometer. (auth)

21212 THERMAL NEUTRON FLUENCE MEASUREMENTS BY THE FISSION TRACK METHOD USING THE STANDARD U GLASSES. Oncescu, M.; Danis, A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 6, 789-791(1973).

Thermal neutron fluence measurements by the fission track method using uranium as the fissionable element in calibrated glasses are described. The constant K from the relation $\Phi = K\rho$ for the reactor conditions was calibrated for U–2 and U–3 standard U glasses by the gold foil activation technique. Makrofol and Melinex plastic SST detectors and a mica muscovite mineral SST detector were used. Neutron fluences for a number of exposures into the thermal column 3 of the VVR-S reactor, Bucharest, were measured. U-235 induced fission fragment tracks were counted at 400 times magnification using an optical microscope. (auth)

21213 NEW SCINTIGRAPHIC IMAGING METHOD. Luig, H. Bonn; Univ. Bonn (1971). 119p. (In German).

Thesis.

A new scintigraphic method has been developed that combines the operating mode and the imaging properties of a gamma camera and a scanner. The device developed for testing this method has been called 'scan-camera' and consists of an automatically movable scanning couch and the commercially available autofluoroscope. The resolving power of the scan-camera is solely determined by the collimators and any resolving power can be obtained in principle. One of the advantages of the scanning couch for practical use in clinics is that it allows the continuous extension of the imaging area beyond the range of the detector. Scintigraphic investigations of the functions of body organs can also be carried out by this device. Some examples of localization diagnoses are discussed by several scintigrams made on different patients. The results of the investigations and tests described in the thesis show that the method offers the possibility to overcome the problems previously encountered in other scintigraphic systems due to their limited resolving power. (GE)

21214 APPEARANCE TIME. I. Theoretical Considerations. Dragu, A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 3, 347-357(1973). (In French).

The appearance time (the time necessary to etch out a track to a projected length in a dielectric track detector) is discussed. (WHK)

21215 AVERAGE RADIANT INTENSITY DETERMINATION OF PULSED NUCLEAR RADIATION BY POWER SPECTRAL DENSITY MEASUREMENT. Sawamura, S.; Ozawa, Y. (Hokkaido Univ., Sapporo). Nippon Genshiryoku Gakkaishi; 15: No. 3, 191-197(Mar 1973). (In Japanese).

The intensive bremsstrahlung emitted from an electron LINAC is pulse modulated with a period of T_0. If these γ bursts are detected with a scintillation detector, the output of the detector reflects the pulse trains with the same period T_0 but with random pulse heights due to the piling up of γ photons. The power spectral density of such piled-up pulse trains has been derived, and it was found that the power spectral density is composed of two parts. One is the line spectra whose interval is $1/T_0$ with amplitude proportional to the square of the average intensity of the incoming bursts. The other is a continuous spectrum due to variations in the intensity of the incoming bursts. This characteristic of the power spectral density can be used to measure the radiant intensity of the γ burst with period T_0 by using a wattmeter connected with a narrow band-pass filter. This method is simpler and less expensive than using the vibrating-reed electrometer, and can be well adapted to use as a survey meter or in a monitoring system. The average intensity of γ bursts was measured with this method, and experimental results are described. (auth)

21216 ADVANCES IN FUNDAMENTAL ASPECTS OF IMAGING SYSTEMS AND TECHNIQUES. Beck, R. N.; Zimmer, L. T.; Charleston, D. B.; Harper, P. V.; Hoffer, P. B. (Univ. of Chicago). pp 3-45 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From Symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB–315(Vol. I); CONF-721017–(Vol. I).

An analysis of the radionuclide imaging process is presented in an outline of the relationships between parameters describing the object, radiation detector system, numerical image, photo-recording system, and exposure image, assuming that the imaging system is linear and shift-invariant. Major image imperfections such as quantum noise and linear distortion are described quantitatively in terms of the sensitivity and spatial resolution of the detector and recording systems. Principles of system design are formulated: the maximum useful detector sensitivity is limited by the size of the smallest structures to be detected; the maximum useful recorder sensitivity is limited by the required signal-to-noise ratio (S/N) or confidence of detection. A theory of optimum-weighted multichannel imaging is described which permits maximization of S/N, utilizing the entire pulse amplitude spectrum. The effects of image processing on noise in the image are described quantitatively: smoothing tends to reduce image noise and increase linear distortion; sharpening tends to have the opposite effects. The use of a recording medium capable of a bipolar response (repeated local storage and erasure) permits on-line image sharpening or reduction of linear distortion that is introduced by the detector system (which is described as a low-pass filter of spatial frequency components comprising the object). The need for a more general formulation of the imaging process, including the effects of nonlinear and nonstationary components on diagnostic image quality, is emphasized. The use of Receiver Operating Characteristic (ROC) curves is suggested as a means for comparing and evaluating diagnostic image quality in terms of the accuracy of the physician's performance in interpreting radionuclide images. The general principles, concepts, and terms used to describe and evaluate radionuclide imaging systems can be adapted to other imaging modes used in nuclear medicine. (57 references) (auth)

21217 EXPERIMENTAL METHODS FOR DETERMINING THE SEPTUM PENETRATION OF FOCUSED COLLIMATORS. Tsialas, S. P.; Psarrakos, K. A. (Greek Atomic Energy Commission, Athens). pp 47-59 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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The main effects of septum penetration on the response of collimator-detector systems are an apparent increase of sensitivity and a deterioration in resolution as compared with the predictions based on collimator geometry. Experimental methods are described for the determination of the septum penetration fraction and the non-geometrical response of the collimator-detector system. Measurements of plane sources of different radioisotopes with the aid of a modified collimator enable the septum penetration fraction to be determined. The inverse Fourier transform is used for the analysis of the response of the collimator to line sources of different radioisotopes and the determination of the non-geometrical response. The results obtained by applying these methods to two commercial collimators and two radioisotopes (^{198}Au and ^{131}I) are presented. (auth)

21218 INVESTIGATIONS OF SEQUENTIAL DISTRIBUTIONS USING A LOW-BACKGROUND WHOLE-BODY SCANNER WITH DIGITAL OUTPUT. Trott, N. G.; Cottrall, M. F.; Wells, D. G.; McCready, V. R. (Royal Marsden Hospital, Inst. of Cancer Research, Sutton, Eng.). pp 61-78 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A well-shielded system incorporating two 125-mm-diameter by 50-mm-thick NaI(Tl) detectors has been developed for use in whole-body radioactivity measurements or area scanning. The detectors are stationary and the system operates by continuous or stepwise movement of the patient on a raster of up to 1.84 m by 0.82 m. Count and position data are recorded on a multichannel analyzer for subsequent digital computer processing. Because of the good stability and reproducibility of the system as well as the data-recording method adopted, particular sites of interest can be selected after a series of measurements spread over periods of days or weeks, and the time variation of counts over these sites determined. The system provides a simplified procedure, with improved accuracy, for the sequential investigation of patients with various forms of anaemia by using low activities of ^{59}Fe (10 μCi) and ^{51}Cr (100 μCi). The equipment is also very suitable for quantitative measurements of the activity in whole organs. Illustrations of clinical applications are given, and problems that arise in selecting optimum resolution and sensitivity for such studies are considered. Other applications of the system to clinical investigations with radiopharmaceuticals, such as ^{58}Co-vitamin B_{12}, ^{67}Ga-citrate and ^{75}Se-selenomethionine, and in the search for metastases in patients undergoing treatment with ^{131}I for carcinoma of the thyroid, are discussed. (auth)

21219 A 70-mm-DIAMETER GERMANIUM DETECTOR MEDICAL RADIOISOTOPE SCANNER. Glass, H. I.; Hudson, F. R.; French, M. T.; Lavender, J. P. (Hammersmith Hospital, London). pp 79-103 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

The suitability for medical radioisotope scanning of 70-mm-diameter planar germanium detectors has been investigated. The energy resolution, sensitivity and line-source response characteristics were measured. No practical problems were found in using a scanner fitted with such detectors. The sensitivity of Ge(Li) detectors is affected by the quality of the germanium and by the thickness of both the entrance window and the depleted layer. The detectors used were found to show a peak in sensitivity between 100 keV and 200 keV which was 0.4 times that of a 75 mm × 50 mm NaI(Tl) crystal. If the NaI(Tl) detector is operated with a narrow analyzer window, a line-source response function which simulates that of a germanium detector may be obtained, but the sensitivity is reduced. An effective sensitivity which enables Ge(Li) and NaI(Tl) detectors to be realistically compared for imaging is proposed and a minimum specification for a Ge(Li) detector to be used for imaging is suggested. In the clinical trial brain scans were performed using ^{99m}Tc on the semiconductor scanner and on a 75-mm-diameter NaI(Tl) scanner using identical collimators. The NaI(Tl) scans were performed with the analyzers set to (a) 126 to 165 keV and (b) 143 to 165 keV. All the data were recorded on magnetic tape and played back to give scans of matched photographic quality and information content. This latter was achieved with a specially built dividing circuit. The clinical results have demonstrated improvement in the Ge(Li) scanner image. Examples show the increased area of brain within which a diagnosis may be made, especially at the base of the brain which is normally obscured by scattered radiation. The potential of the semiconductor scanner was also examined in specialized investigations, one example of which is the simultaneous scanning of ^{67}Ga and ^{111}In to investigate differences in their uptake in the same patient. All cases reported as doubtful after routine scintigraphy are now examined on the semiconductor scanner. (auth)

21220 DESIGN AND SOME CLINICAL APPLICATIONS OF A HYBRID SCANNER. Crawley, J. C. W.; Veall, M. (Medical Research Council Clinical Research Centre Harrow, Middlesex, Eng.). pp 105-112 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

In the authors' hybrid scanner 30 sodium-iodide crystals, each 2 in. × 2 in. × ½ in., are optically coupled to form an assembly 2 in. × 2 in. × 15 in. long. Photomultipliers at each end of the assembly are connected to analogue circuits which give signals proportional to $\sqrt{V_A V_B}$ and log V_A/V_B, where V_A and V_B are the amplitudes of the photomultiplier pulses for a single scintillation. The light loss at the crystal interface results in an exponential decay along the crystal so that the $\sqrt{V_A V_B}$ signal is proportional to the gamma-ray energy and the log V_A/V_B signal to the position of the scintillation along the crystal. The patient passes the crystal on a moving couch. Pulses from the analogue circuits, and a potential proportional to the position of the couch, are used to build up a picture on a cathode-ray tube. With small additions to the circuitry, the instrument can be used as a profile scanner and whole-body shadow shield counter at the same time. The instrument has been used for the whole-body bone scans using ^{18}F, and the results compared with those obtained with a rectilinear scanner. No skeletal secondary picked up by the rectilinear scanner was missed by the hybrid scanner and the latter was considerably faster. The results of these studies, together with examples of other clinical uses of the instrument, are discussed. (auth)

21221 BEDSIDE SCINTIGRAPHY: RESULTS OBTAINED WITH THE HELP OF A PORTABLE HYBRID SCANNER. Planiol, T.; Floyrac, R.; Itti, R.; Pourcelot, L.; Berson, M. (Laboratoire de Biophysique Medicale, Tours, France). pp 113-119 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

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The equipment used in nuclear medicine is often heavy and cumbersome. This precludes the examination of patients who cannot be transported. Portable measurement units are now being developed which contain a single-channel probe and a recording device. These units are adapted for certain dynamic studies or for counting and do not allow morphological examinations. The development of new light detectors not requiring a complex mechanical system for scanning in two directions has allowed serious consideration to be given to the construction of scintigraphic units that can be brought to the patient's bedside. The portable device uses a detector designed at the Clinical Research Centre at Harrow consisting of a stack of 40 sodium iodide discs with a photomultiplier at each end. It needs to be moved only in a direction perpendicular to its axis; consequently, it has been possible to make a unit light enough to be mounted on a rail fitted to the two ends of a bed. The physical characteristics of this unit make it particularly suitable for the use of technetium-99 and xenon-133. Its most obvious application is for the diagnosis of pulmonary embolisms, but in principle it lends itself to the examination of any patient who cannot be transported. Examples of clinical results are given. (auth)

21222 LINE-DETECTOR RADIOISOTOPE SCANNER WITH TOMOGRAPHIC CAPABILITIES. Miraldi, F.; Yon, E. T.; Rejali, A. (Case Western Reserve Univ., Cleveland). pp 121-132 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A radioisotope scanner which utilizes a line detector has been developed and constructed at our institution. A scintillation crystal in the form of a bar with approximate dimensions 3 cm × 3 cm × 30 cm forms the gamma sensing element. The crystal lies behind a collimator which focuses to a line parallel to the crystal axis, and a scan is obtained by making a single pass over the body with this detector. One co-ordinate of a detected gamma is determined by sensing the linear displacement of the crystal and the other by finding the scintillation position along the crystal axis. Scintillation position along the axis is determined by operating on the output from the ends of the crystal bar. Detected gamma positions are displayed on an oscilloscope and a time exposure is made. Since

only a uni-directional motion is required, high scanning speeds are easily obtained. The narrow crystal bar permits the design of a line-focusing collimator with a deep field of view but which can be quite thin; thus, the system has a high sensitivity without degradation of resolution. In the present system, 1-cm resolution is obtained with a sensitivity of 2.5×10^{-6} per square cm of crystal surface for ^{99m}Tc which compares well to the Pho-Gamma III Scintillation Camera with an approximate sensitivity of 0.4×10^{-6} per square cm. Finally, system versatility lends itself to other applications of which the most important is tomographic scanning. Tomography is accomplished using a crossed field technique. In this machine, data from passes from various directions are digitalized and stored on tape. To obtain crossed fields, a simple analog shift in the data display of each pass is used before summing all data on the display oscilloscope. Playback can be adjusted to reinforce any given level by altering the analog shift; thus, an infinite number of levels can be obtained as required. An instrument combining these principles to provide capabilities of ordinary organ scanning, total body scanning, and tomographic scanning is presently in operation at University Hospitals of Cleveland. Details of its operation as well as clinical and phantom studies are discussed. (auth)

21223 FOUR-VIEW COMPUTER SCINTISCANNING: IMAGE STRUCTURE THROUGH MULTI-WINDOW PULSE-HEIGHT ANALYSIS. Genna, S.; Teager, H. M.; Shore, H. H.; Zimmerman, S.; Pang, S. C.; Burrows, B. A. (Veterans Administration Hospital, Boston). pp 133-154 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A radionuclide imaging system was fabricated to develop new methods of executing and analyzing scintiscans. The system is computer controlled and monitored, i.e., computer programs execute the data collection procedures from simple operator commands and collect and store count-rate data for on-line and subsequent analysis. Currently, four detectors simultaneously image four geometrically correlated views and three independent pulse-height analyzers delineate the windows from which count data are collected. Computer control has resulted in standardization of procedures, minimization of set-up errors, and significant time efficiencies. A typical procedure may take 10 to 20 per cent of the time required with manually manipulated single detector scanners. Four simultaneous views permit optional combination of the data from opposing heads and accurate anatomical correlation. Furthermore, standard data processing and presentation routines, e.g., spatial filtering, area count density determinations, simple symmetry analysis routines, etc., assist diagnostic interpretation. The image-forming characteristics of devices employing scintillation detectors are currently derived from single-channel analysis of scintillation events. A more general method of image formation through linear superposition of counts from two or more discrete pulse-height analyzed windows is formulated. The principle of linear superposition of counts recorded in different regions of the pulse-height spectrum has been applied to single and dual radionuclides. This results in significant modification of the image-forming characteristics (MTF) through which image sharpening and more accurate contrast ratios may be achieved. In dual radionuclide measurements (^{99m}Tc and ^{113m}In) the method effectively eliminates cross-talk counts which arise from the higher-energy gamma rays and are recorded in the ^{99m}Tc photopeak. Results are illustrated by spread functions, modulation transfer functions and by responses to simple geometrical radionuclide distributions. (auth)

21224 TOWARDS A FINE-RESOLUTION IMAGE-INTENSIFIER GAMMA CAMERA: THE ABER-GAMMASCOPE. Mitchell, J. G. (Univ. of Aberdeen, Eng.); Mallard, J. R.; Egerton, I. B.; Caldwell, A. B.; Lakshmaman, A. V.; Nunan, C.; Turnbull, W. pp 157-167 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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Scintillations from a large flat NaI crystal are imaged with a lens system onto the photocathode of a sensitive, switched image-intensifier tube. Good in-phantom results have been obtained, images of 3-mm bars being achieved, but poor clinical results. The reason for this was sought by studying the equipment as a whole, and then the individual components. Although some of the trouble could be attributed to energy-degraded Compton-scattered gamma rays in the patient, much was due to the scatter of light within the instrument. Improved energy discrimination of the system used to switch the image-intensifier tube decreased the Compton-scatter component to acceptable limits. The effect of the scattered light was studied by examining the spread of light from a sharply defined edge (a) as presented to the complete instrument, and (b) as presented to the three major components: (i) crystal, (ii) lens and (iii) image intensifier. The conclusion drawn was that the crystal was the major offender, the mechanism probably being due to partial scatter of totally internally reflected light on its way to the edge of the thin flat crystal. Suggestions for improving this are discussed. The performance of the lens used is also discussed from the point of view of (a) its resolution, and (b) its light-gathering power defined as the ratio of image intensifier scintillations to crystal scintillations. Some results with solid-state equipment are presented to study pulse-height analysis requirements. (auth)

21225 LARGE-AREA, HIGH-RESOLUTION SCINTILLATION CAMERA BASED ON DELAY-LINE TIME CONVERSION. Tanaka, E. (National Inst. of Radiological Sciences, Anagawa, Japan); Nohara, N.; Kumano, N.; Kakegawa, M. pp 169-180 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A new scintillation camera utilizing a 387-mm-diameter NaI(Tl) crystal viewed by thirty photomultipliers has been constructed. The effective field of view is 340 mm in diameter which is sufficiently large to cover both lungs in one view. The camera can be used with any one of three parallel-hole collimators (1500, 6000, and 30,000 holes), a pin-hole collimator and a rotating collimator (2300 holes, 30° slanted) for tomographic imaging. The position computation is based on the time conversion method: signals from the photomultipliers are fed to intermediate taps of two delay lines, each for the X- and Y-axes, so that the position information of each scintillation is converted to time delay of the signal, the signals appearing at both ends of each delay-line are doubly clipped to form bipolar pulses by suitable pulse shaping circuits, and the difference of zero crossing time of the bipolar pulses is converted to position signal. With this method, the intrinsic spatial resolution is almost optimized for the given detector configuration by the fact that the contribution of each photomultiplier to the position computation is approximated to be theoretical optimum. The intrinsic resolution for ^{57}Co is about 8.4 and 8.0 mm (FWHM) for the X- and Y-directions, respectively. The coarse uniformity in the field of view was adjusted by the gain of the photomultipliers, and the fine uniformity around each photomultiplier was adjusted by controlling the circuit parameters of the pulse shaping circuits, the possibility of the latter being a special feature of the delay-line position computer. The fundamental performance of the camera and an evaluation of the camera system with emphasis laid on the different features compared with the other Anger scintillation cameras are given. (auth)

21226 16-INCH-DIAMETER GAMMA-CAMERA BASED ON DELAY-LINE ARITHMETIC. Cooke, L. (Conuclear Ltd., Ottawa); Cradduck, T. D.; Hughson, E. J.; Hummel, R.; Thorsteinson, T. M. pp 181-191 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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One of the earliest gamma-cameras described by Anger utilized an 8-in.-diameter crystal which was viewed by seven photomultipliers. A later development, which is the one which has been commercially exploited, utilized a larger diameter crystal (11.5-in.-diam.) and 19 photomultipliers. This basic configuration has been subjected to considerable improvement over the years, though such development has largely been aimed at improving the inherent resolution of the system. One major deficiency has remained. It is the limitation imposed upon the field of view due to the size of the detector. Most lungs cannot be visualized with a 10- or 11-in.-diameter field of view and some other organs — notably the liver-spleen and kidneys — can prove troublesome. Several difficulties have prohibited the extension of the Anger gamma-camera to larger diameters. First and foremost among these was the inability of the crystal manufacturers to produce larger diameter crystals. The second was a lack of trust in the stability of photomultipliers when as many as 37 would be required in a larger detecting system, and the third difficulty was imposed by the inherent noise problems associated with the conventional methods used to produce the position signals. In recent years the crystal manufacturers have been able to produce larger diameter crystals and the instability of photomultipliers diminished considerably with the introduction of bi-alkali photocathodes. The third problem was answered by Tanaka and his co-workers who postulated the use of position arithmetics based upon delay lines. As a consequence of

these developments a gamma-camera has been produced which utilizes a 16-in.-diameter crystal, 37 photomultipliers and delay-line arithmetic. Performance to date indicates a field of view of 15-in.-diameter with a uniformity equal to earlier devices. The inherent resolution is of the order of 0.25-in. and linearity of the system is good. Further development is expected to yield even better resolution and also to result in a gamma-camera which will have a better resolution and sensitivity at higher energies than is presently the case. Performance figures and some clinical results are presented. (auth)

21227 SEMICONDUCTOR GAMMA-CAMERA: ASSESSMENT OF RESULTS. Parker, R. P. (Inst. of Cancer Research and Royal Marsden Hospital, Sutton, Eng.); Gunnersen, E. M.; Ellis, R.; Bell, J. pp 193-216 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

A small (44 mm × 44 mm) prototype gamma-camera with Ge(Li) as the detecting element, and based on the orthogonal strip principle, has been developed and built by the UKAEA and has undergone trials in collaboration with the Royal Marsden Hospital. The semiconductor approach was used because (i) there is no optical stage, (ii) good spatial and energy resolution is possible, and (iii) digital output is easily accomplished. Results of a comparative assessment of the performance of the semiconductor camera and of a conventional Anger-camera are given. It is shown that in practice the improved energy resolution achieved with the semiconductor device enables a high proportion of the scattered radiation to be discarded when imaging radioactive sources within tissue, and is of great assistance when investigating multinuclide sources, those possessing a complex gamma spectrum, and low-energy gamma-ray emitters. Particular attention is given to the factors affecting spatial resolution and efficiency. Experimental and theoretical data will be presented on the effect of scatter in the detector, from the collimator, and within tissue. The sensitivity of both cameras has been measured; estimates will be given of the counting-rates to be expected in various clinical situations. This work has shown that a small-area semiconductor gamma-camera constructed from germanium is feasible: the images obtained of both phantoms and patients were clearly superior to those taken with the Anger-camera. The practical problems which remain are related to detector life-time and uniformity. Preliminary investigations on the potentiality of intrinsic Ge will be reported. The current development of alternative semiconductors of higher atomic number affords the possibility of efficiencies greater than NaI(Tl) and room-temperature operation. These are discussed and calculated efficiencies presented. (auth)

21228 APPLICATIONS OF HIGH-RESOLUTION SEMICONDUCTOR DETECTORS IN THE EVALUATION OF TUMOUR-LOCALIZING TRACERS. Brill, A. B.; Patton, J. A.; Price, R. (Vanderbilt Univ., Nashville). pp 217-240 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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Systems evaluation studies have been conducted with a 16-mm-diameter high-resolution Ge(Li) detector and a 52-mm medium-resolution Ge(Li) detector. A 23-mm diameter Si(Li) detector has been used with a 17 Ci ^{241}Am source for fluorescence X-ray mapping studies. The detector response is collected in a PDP/9 computer. Unprocessed data are displayed on standard scanner output systems and compared with computer-adjusted data. The results of these studies suggest that high-resolution Ge(Li) detectors presently available are too low in sensitivity for most clinical applications. The Si(Li) detectors show great promise, especially for thyroid studies. The role of computer processing of high information content low photon density studies is discussed. Results of animal studies using multiple tracers simultaneously for tumor localization are presented. The ability to map the distribution of multiple tracers at several times facilitates a comparison of the utility of different agents and provides improved estimates of radiation dosimetry. Results of a study carried out to evaluate the utility of ^{67}Ga for tumor localization are used to illustrate the method. (auth)

21229 PROTOTYPE, ULTRA-PURE GERMANIUM, ORTHOGONAL STRIP GAMMA-CAMERA. Detko, J. G. (Sloan-Kettering Inst. for Cancer Research, New York). pp 241-254 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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Recently available ultra-pure germanium (impurity concentration less than $2 \times 10^{10}/cm^3$) has been successfully utilized in the construction of a small prototype semiconductor gamma-ray camera. The use of ultra-pure germanium in the detector assembly eliminates the need for the troublesome lithium-drift process in diode production and results in a more stable device. This satisfies a basic requirement for the production of a large-area camera suitable for practical clinical use. Elimination of the lithium-drift process also removes the need for cryogenic cooling, except during operation. The camera employs the orthogonal strip geometry which was originally developed in this program in a lithium-drifted silicon diode and has since seen use in lithium-drifted germanium. The orthogonal strip configuration reduces the number of required amplifier channels for an (n × n) cell matrix from n^2 to 2n compared with an individually monitored (n × n) cell detector array. It also reduces to a tractable level associated problems of diode mounting and electrical contacts. A spatial resolution of within 4 mm for ^{57}Co (122 keV) over a (2 × 2) cm matrix has been obtained with the present experimental system which is briefly described. Basic electrical and operational characteristics of the matrix are presented along with results in imaging distributed radionuclides in phantoms and in small mammalian organs. (auth)

21230 IMAGE INTENSIFIER GAMMA-RAY CAMERA AND ITS VARIANTS. Moody, N. F.; Joy, M.; Paul, W. (Univ. of Toronto). pp 255-267 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A gamma-ray camera of $^3/_{16}$-in. picture element separation has been built for static and dynamic studies and is about to undergo clinical evaluation. Results are presented. The instrument features a CsI(Na) mosaic of some 1500 elements which is 9 in. in diameter by 1-in. thick. Any gamma emitter in the range 80 to 500 keV may be used, and the energy resolution of the system is expected to be 12 to 15% FWHM at 280 keV. Thus there is excellent rejection of Compton scatter, background and thermal noise. This instrument is equally suitable for static studies with low counting rate or dynamic studies with rates up to ~1.2×10^6 counts/min. Future improvements should allow a threefold increase in the maximum rate. The system consists of an image intensifier of 9 in. diameter photocathode on an 0.08 in. glass window with which the mosaic is in optical contact. Succeeding intensifier tubes with 25- to 40-mm-diam. fibre-optics input/output plates enhance the gain to a level suitable for coupling to a videcon camera with associated display monitor. At one point in the intensifier chain the light is split so that photomultipliers can assess event energy. A single-channel analyzer driven from these photomultipliers is able to control one of the intensifiers, which thus acts as a camera shutter, transmitting only events of photopeak energy. The commercial practicability of such a camera is critically dependent on the development of techniques by which the mosaic can be made inexpensively. The authors have overcome this problem, and shall outline a process which adds very little to the cost of the raw CsI(Na). Several camera variants have been devised for specialized applicants. One of these is intended for neurosurgery, where it is often necessary to study cerebral blood circulation. For this purpose, a fixed crystal mosaic structure often imposes undesirable restrictions, and the authors describe an experimental instrument which promises to permit the placing of individual mosaic elements in any geometrical arrangement desired by the operator. (auth)

21231 RECENT ADVANCES IN FRESNEL ZONE-PLATE IMAGING. Barrett, H. H.; DeMeester, G. D.; Wilson, D. T.; Farmelant, M. H. (Raytheon Co., Waltham, MA). pp 269-284 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A Fresnel zone plate, used as a coded aperture, gives a very large increase in geometric collection efficiency over conventional collimators. The image, however, is not directly recognizable, but is obtained in a coded or scrambled form. Decoding is carried out with a coherent optical processing system. Initial work on applying this aperture to nuclear medicine used an Anger camera as the image detector. However, the poor resolution of the camera severely limited the attainable image quality. A system in which the coded image is recorded directly on x-ray film is described. The film is much slower than an Anger camera, but with the high efficiency of the zone plate, reasonable exposure times and doses

can be used. The high spatial resolution of the film permits the use of an off-axis zone plate which gives much better images than the on-axis one used previously with the Anger camera. The use of a half-tone screen is required to heterodyne the object spectrum into the spatial frequency passband of the off-axis zone plate. Representative images obtained with this system are shown and possible ways of increasing the sensitivity are discussed. The effect of scatter is also briefly discussed, and a means of effectively discriminating against it, at least for low-energy isotopes, is suggested. Finally, a system for transmission scanning is described in which the source rather than the aperture is coded in a zone-plate pattern. (auth)

21232 TOTAL ORGAN KINETIC IMAGING MONITOR: SYSTEM DESIGN AND APPLICATIONS. Monahan, W. G.; Beattie, J. W.; Powell, M. D.; Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research and Memorial Hospital for Cancer and Allied Diseases, New York). pp 285-298 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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The Total Organ Kinetic Imaging Monitor (TOKIM) system consists of: (1) two Anger-type scintillation camera detectors using 34.3 cm × 1.3 cm NaI(Tl) crystals; (2) associated pulse-height analysis, coincidence, position and computer interface electronics and (3) an IBM-1800 computer. The cameras are operated on-line with the computer for both static imaging and dynamic function studies. Three modes of operation have been explored with this system: (1) positron mode in which the opposed detectors are used in coincidence to detect annihilation photons; (2) 90° correlation mode, in which the detectors are equipped with collimators and oriented at 90 degrees, for observing cascade gamma rays in coincidence; (3) multiprobe detector mode with the detectors used separately for dynamic studies. In all three modes the x−y co-ordinates or pairs of co-ordinates are buffered to magnetic tape and later recalled and accumulated in 64 × 64 matrices. These matrices are either printed out in an alphanumeric display with standard deviation increments or displayed in isomeric or density forms on a storage oscilloscope. The main advantage of the positron mode for tomographic imaging is its good resolution. For a crystal separation of 50 cm the point source resolutions (FWHM) in lateral and axial planes are 1.25 cm and 3.0 cm, respectively. Since the detectors subtend large solid angles, high singles counting rates are experienced which limit the coincidence rate to about 1000 counts/sec. In the 90° correlation mode the singles rates are low, but a required real to random coincidence ratio of 10 : 1 yields a coincidence rate of only 3 counts/sec. However, the detection of cascade gamma rays in coincidence by collimated detectors has enabled the three-dimensional resolution of deep-lying voids without interference from surrounding activity. The single heads of the TOKIM have been used in dynamic function studies with cyclotron-produced radionuclides ^{15}O, ^{13}N, and ^{11}C. For these studies, the data are replayed and accumulated for preset time increments in areas of interest. The integrated counts are corrected for radioactive decay, plotted and fitted to a series of exponentials to determine clearance times. These studies include the transport of radioactive gases from the lungs and metabolic studies with ^{13}N-labelled ammonia. (auth)

21233 DESCRIPTION OF A NEW HIGH COUNT-RATE GAMMA-CAMERA SYSTEM. Jones, R. H.; Grenier, R. P.; Sabiston, D. C. Jr. (Duke Univ., Durham, NC). pp 299-312 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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Development of dynamic quantitative radionuclide studies of the cardiovascular system has defined a need for a high count-rate gamma-camera. Spatial data distortion which occurs at high counting rates limits use of current gamma-cameras to maximum rates less than 30,000 counts/sec. These maximum counting rates for the entire detector field are insufficient to accurately delineate changes within individual cardiac chambers during a single cardiac cycle. In addition, long electronic dead-times of current instrumentation introduce significant data distortion at high counting rates. This study describes performance characteristics of a new multicrystal gamma-camera system designed to achieve high counting rates. Spatial orientation of counts from a matrix of individual scintillation crystals is retained by an array of photomultiplier tubes, preamplifiers, and amplifiers. Shaped amplifier pulses pass simultaneously to a low-level discriminator to assess spatial accuracy and to a single-channel analyzer for pulse-height analysis. A random-access, solid-state buffer memory stores all valid events. At selected time intervals, counts accumulated in the buffer memory pass to a magnetic core memory for analysis or storage on magnetic tape. The dead-time of this system approaches the one microsecond inherent scintillation decay time required by sodium iodide crystals. At rapid counting rates, the observed dead-time becomes a complex function which cannot be described by the usual expression. The total counting rate achieved by an instrument which retains discrete spatial orientation of counts provides a practical index of the speed of data processing. The system described has proven capable of recording counting rates up to 200,000 counts/sec. This high counting rate was achieved without alteration of field uniformity or event positioning. Moreover, improved statistics resulting from this counting rate enhances the accuracy of dynamic studies. Preliminary observations with this instrument indicate its potential usefulness for high frequency organ studies. (auth)

21234 POSITRON SCINTIGRAPHY WITH SHORT-LIVED CYCLOTRON-PRODUCED RADIOPHARMACEUTICALS AND A MULTICRYSTAL POSITRON CAMERA. Brownell, G. L.; Burnham, C. A.; Hoop, B. Jr.; Kazemi, H. (Massachusetts General Hospital, Boston). pp 313-330 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

Positron scintigraphy in a variety of clinical applications has been carried out with the Massachusetts General Hospital (MGH) multicrystal positron camera, using a number of radiopharmaceuticals labelled with ^{13}N, ^{15}O, ^{18}F, and ^{68}Ga. Compounds labelled with ^{13}N, ^{15}O, and ^{18}F were obtained from the MGH cyclotron. Fluorine-18 was also produced in the Massachusetts Institute of Technology research reactor, and ^{68}Ga was obtained from a nuclide generator. The positron camera has been used in the static mode to obtain images with spatial resolution better than 1.0 cm and in a dynamic mode to obtain sequential images with a time resolution of as small as 0.1 sec. The preliminary studies include: (1) distribution of pulmonary ventilation and perfusion in laboratory animals and in patients, using ^{13}NN in gaseous form and dissolved in saline; (2) distribution of body ammonia, myocardial scanning and localization of surgically produced myocardial infarct in dogs using $^{13}NH_3$; (3) distribution of pulmonary perfusion and lung water in man using ^{15}O-labelled CO_2 and similar comparison studies in an isolated lung preparation using ^{15}O-labelled H_2O and CO_2; (4) visualization and high-resolution imaging of skeletal structure in laboratory animals using $Na^{18}F$; and (5) distribution of aerosol deposition in lungs of laboratory animals using particles labelled with ^{68}Ga. In these studies, data were collected, processed and displayed with the aid of a versatile Nuclear Medicine Image Computer System (NUMEDICS). The processing routines that have been used most frequently in these studies include digital filtering and smoothing of images, ratio, difference, or sum of two images; and "region-of-interest" definition and summing of counts in sequential images. At the present time, scintigraphic images are displayed by means of a raster-type oscilloscope display and numerical data are displayed via a teletype. The studies to date adequately demonstrate the potential clinical value of positron scintigraphy, with short-lived positron-emitting radiopharmaceuticals useful in a number of clinical applications. (auth)

21235 ANALYSIS OF TOMOGRAPHIC SCANNING SYSTEMS. Myers, M. J.; Keyes, W. I.; Mallard, J. R. (Univ. of Aberdeen, Eng.). pp 331-345 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

In order to exploit fully developments in longitudinal and transverse tomographic scanners an understanding of their relative capabilities and their applications to various clinical situations is essential. The design of two instruments, the interfacing of them to a computer system and the data processing involved in extracting and displaying quantitative data and structural detail in true sections is discussed. A scanning camera system consisting of 30-cm crystal gamma-camera, focusing collimator and moving couch with position sensors has been built for longitudinal tomography. The electronic analysis and display unit gives both an immediate color analogue display of five sections and, simultaneously, five image arrays in the computer memory. Transfer operations on these composite images that allow the blurred components from other planes to be stripped away to leave the data from single sections are described. A second system consists of an opposed pair of counters successively passing over and rotating about the patient to yield transverse section tomograms. The multiple views are processed by the computer to compensate for the

effects of the collimator response in-tissue and for the summation of different views at finite angular increments. The processed data from both tomographic systems is displayed life-size by a specially designed digital color printer. Preliminary experiments indicate that the transverse section system offers better differentiation between planes, more direct translation of the composite pictures to indicate quantitatively the activities present and more clinically useful sectional views of, for example, the brain. The longitudinal section scanner is shown to give better resolution in the plane of the section and unlimited scanning area, with a number of simultaneous sections (rather than individual tomograms following a conventional survey scan) possible. (auth)

21236 QUANTITATIVE SECTION SCANNING. Kuhl, D. E.; Edwards, R. Q.; Ricci, A. R.; Reivich, M. (Univ. of Pennsylvania, Philadelphia). pp 347-353 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

Orthogonal tangent correction (OTC) is introduced as an improvement of the processing technique for transverse section imaging. The initial step in this processing technique is to take an orthogonal pair of tangent data lines and form a matrix distribution that reflects the proportionality that exists between them. The matrix data are then redistributed to conform to the proportionality of each succeeding orthogonal pair of tangent lines without destroying the compatibility achieved in previous steps. The final section matrix is a high contrast image of the cross-section, the matrix distribution is compatible with all tangent values, and there is a linear relationship between matrix counts and radioactivity in the scanned object. We have already applied orthogonal tangent correction to clinical brain scanning with advantage, but we regard its more important role to be as another significant step toward quantitative imaging for estimating radioactivity localized in three dimensions. (auth)

21237 A NEW MODE OF COLLECTION AND DISPLAY OF THREE-DIMENSIONAL DATA FOR STATIC AND DYNAMIC RADIOTRACER STUDIES. Patton, J. A.; Brill, A. B.; King, P. H. (Vanderbilt Univ., Nashville). pp 355-368 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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Several different approaches have been used to obtain cross-sectional or tomographic images of static radioisotope distributions with varying degrees of success. None of these have been capable of mapping rapid dynamic functions. We have constructed a transverse-section scanning device consisting of eight NaI(Tl) detectors arranged in a cylindrical array and optimized for brain scanning. The detectors are driven such that their fields of view are swept through the scanning area and counts versus angular position are recorded from each detector. Static data of excellent statistical quality can be collected in less than one minute. Less than one minute of computer time on a small computer (PDP-9) is required for image analysis and display. The drive system is currently being refined to permit image collection times of one to two seconds. Thus, the system has potential applications in dynamic function studies. Three or four levels of detectors could then be used to obtain three-dimensional views of changing radioisotope distributions. By storing the data separately from each detector we are able to utilize data rejection and enhancement techniques to reduce the "star" effect inherent in transverse-section tomography. Results of phantom and clinical studies with this system are presented along with image construction techniques utilizing a small computer. (auth)

21238 METHOD OF TOMOGRAPHIC IMAGING WITH DIFFERENT COLLIMATORS. Arimizu, N. (National Radiological Inst., Chiba, Japan). pp 369-379 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

The purpose of the study was to enhance the practice of scintitomography and to improve the quality of the image by an appropriate choice of collimator and method. Scintitomography is possible by the selective demonstration of an image of the target layer, while the images of other layers are blurred, or the exclusive detection of radioactivity in the target layer. The former method, which is similar to x-ray body-section radiography, can be realized by the use of a standard scintillation camera with an angled multiparallel-hole collimator, a pin-hole collimator, or a diverging or converging collimator. Angled multiparallel-hole collimators have been most used recently. The quality of the scintitomographic image is not yet good enough and there is room for further improvement. A pin-hole collimator provides images of better quality at the expense of reduced sensitivity. A converging collimator provides a useful compromise between the requirements of sensitivity and resolution. The selection of a radionuclide emitting gamma rays of appropriate energy makes it possible to use the exclusive detector method for scintitomography with a conventional scintillation scanner. Indium-111 is a radionuclide emitting two gamma rays in cascade. Gamma rays emitted in the region of the focus have high probability of reaching the NaI crystal through the holes of the collimator. Such events appear in the sum-peak of the gamma-ray spectrum. Sum-peak scans do not, however, give selective visualization of sources in the focal plane when the sources are in a water phantom, because of the extremely low efficiency of counting events in the sum-peak under such conditions. (auth)

21239 DESIGN OF A SCINTILLATION CAMERA TOMOGRAPHIC SYSTEM AND INVESTIGATIONS OF ITS PERFORMANCE. Cottrall, M. F. (Inst. of Cancer Research, Sutton, Eng.). pp 381-408 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

A rotating couch and collimator system of the Follet-Muehllehner type has been built and used for tomography with the scintillation camera. The camera head can be set up either above or below the couch. The angulation of the parallel holes of the collimator is 45°, and the radius of couch rotation 15 cm. These parameters result in large differences in the displayed appearance of objects containing activity compared to that obtained with a normal parallel-hole collimator. The theory of image formation by this method and its relationship to other methods of radioisotope tomography are described. The results of phantom experiments are used to illustrate differences from established techniques of scintigraphy. Clinical applications using ^{99m}Tc are described and a critical appraisal made of the potential utility of the technique for clinical diagnosis. (auth)

21240 THREE-DIMENSIONAL SCINTIGRAPHY WITH AN ANGER CAMERA AND A DIGITAL COMPUTER. Schmidlin, P. (Deutsches Krebforschungszentrum, Heidelberg). pp 409-417 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

The method of iterative separation of sections developed for the positron camera has been applied to the Anger camera. The object is measured in four directions. By iterative correction of the activity distribution of the object, an isotropic three-dimensional scintigram is obtained. The method is discussed and results are given. (auth)

21241 ADVANCES IN DATA-PROCESSING TECHNIQUES. MacIntyre, W. J. (Case Western Reserve Univ., Cleveland). pp 421-442 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

Since the time of the early reports in 1964, computer processing of scintigraphic data has rapidly increased until at the present time it is occupying an important position in many nuclear medicine laboratories. Data processing may now be considered to be concerned with four objectives: Presentation of quantitative displays, correction of limitation of data acquisition, attenuation and/or enhancement of selected spatial frequencies, and derivation of secondary parameters indicative of organ function. Although it may take some time before the results of improved visualization of scanning data may be shown to increase clinical accuracy there is no question that in the last category, functional scanning, procedures have been developed for routine clinical application that previously could not be attempted. (52 references) (auth)

21242 DATA ACQUISITION AND PROCESSING SYSTEM FOR RAPID DYNAMIC INVESTIGATIONS WITH A SCINTILLATION CAMERA. Bitter, F.; Adam, W. E. (Univ., Ulm, Ger.). pp 443-457 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

A PDP-12A computer was connected to a scintillation camera.

To fulfil the conditions for rapid investigations, especially for heart investigations, a so-called software system was written which allows data acquisition and storage without losses. Data processing includes handling of areas of interest, manipulation of time-activity curves, smoothing and correcting procedures, calculation of mean transit and circulation times, etc. Everybody in nuclear medicine who uses a scintillation camera is going to employ a computer for data acquisition and processing. The paper describes the demands on such a system, the minimum configuration needed and the useful features for convenient use; it should help people in evaluating their system. Hardware and programming experience is described. (auth)

21243 PRACTICAL APPLICATION OF THE COMPUTER IN RADIONUCLIDE IMAGING. Wagner, H. N. Jr.; Natarajan, T. K.; Knowles, L. G.; McEwan, C. E. (Johns Hopkins Medical Institutions, Baltimore). pp 459-484 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

At the previous IAEA Symposium on Medical Radioisotope Scintigraphy in 1968 the authors described their image display and analysis system (IDA) developed for radionuclide imaging. Over the past four years the system has been used in the Johns Hopkins Nuclear Medicine department and has been found to be of value in brain, thyroid, lung, cardiovascular, liver, and renal imaging. The following characteristics of the system have been common to all applications: (1) A series of images of the distribution of the tracer obtained over a period of time are viewed to select the areas of interest. (2) A combination of programs and light-pen operations are used to flag the areas of interest in all serial images. (3) Questions such as the activity and area of selected regions, the significance of differences in counting rate, and the time-course of activity within such areas are answered by the computer. (4) The data are displayed in the form of a functional image in which numerical data pertaining to specific regions are displayed in shades of grey. Such images are supplemented by printed or graphic display. Examples of usefulness to date include: (1) Target–non-target ratios as a function of time in radiopharmaceutical studies; (2) Regional cerebral blood-flow estimation; (3) Structural and regional functional evaluation of the thyroid within 20 min; (4) Regional ventilation and perfusion in transplantation research and detection of minimal obstructive lung disease; (5) Quantification of perfusion defects in pulmonary embolism, infection and obstructive lung disease; (6) A new quantitative test of gall bladder function; (7) Quantification of renal function in patients with renal transplants and hypertension; and (8) Quantitative evaluation of hypoplastic and hyperplastic regional bone marrow function. (auth)

21244 COMPUTER-ASSISTED DYNAMIC AND STATIC STUDIES PERFORMED WITH THE GAMMA-CAMERA. Hasman, A.; Groothedde, R. T. (Univ. of Nijmegen, Netherlands). pp 485-492 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721027-(Vol.1).

Two computer programs developed to expand the usefulness of a Picker Dynacamera system are described. The first of these, designed to replace the program provided by the manufacturers, offers the possibilities of correction for non-uniformities of the crystal, display of pictures in 8 grey shades or 16 colors, display of distribution of counts in horizontal or vertical slices as profile histograms, comparison of total counts in up to 24 regions of interest, and dynamic studies on up to 24 regions of interest over up to 100 time increments. Illustrative examples are presented. The second, designed for pancreas scintigraphy, makes it possible to subtract the contribution of the overlapping liver from the pancreas image without the need for a subjective estimation of a subtraction factor. (auth)

21245 COMPUTERIZED SYSTEM FOR GAMMA-CAMERA DATA ACQUISITION AND IMAGE PROCESSING. Sjoelin, P. G. (Aktiebolaget Atomenergi, Studsvik, Sweden); Gauffin, C.; Bjoerkman, J.; Forslo, H. pp 493-500 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

A computerized apparatus for data collection and scintigram processing in conjunction with a Nuclear Chicago Pho/Gamma III gamma-camera has been developed. Features of the system are good spatial resolution, speed, facilities for simultaneous recording of images from two isotopes and a display system allowing image storage, intensity modulation and selective erase. The circuitry connecting the gamma-camera to the computer contains two variable threshold single-channel analyzers, one for each isotope, facilities for pile-up rejection and window-width correction and a pair of Wilkinson-type analog-to-digital converters operating at 50 MHz clock frequency. The conversion accuracy is 7 bits given an image resolution of 128 × 128 picture points and a pulse pair resolution of less than 5 μsec. The display system is built around a Hughes-type 639 Scan Converter Memory which, in addition to properties already mentioned, features a zooming attachment for studying picture details as well as a cursor joystick for identifying points and areas in the image for computer treatment. The video output of the scan converter is fed through a converter/modulator circuit to a television monitor or a standard television receiver in color or in black and white. The intensity modulation allows at least eight different levels to be recognized on the screen, either as colors or grey shades. The system computer is a 12 K, 16-bit machine. Varian 620/L, fitted with a console teleprinter and a 1.2 megabyte moving head disc. The disc is used as storage for system programs and collected data. Programs developed include routines for various types of data acquisition such as static and dynamic studies, generating digital images in computer core or transferring lists of values from the ADCs to the disc storage for later sorting to pictures. Display routines, allowing images to be presented either as point pictures or isolevel curves, programs for smoothing, corrections for uneven response of the camera, image point to point arithmetics, computing and displaying clearance curves and other time-dependent functions etc. are also included. (auth)

21246 CLINICAL AND RESEARCH QUANTITATIVE NUCLEAR MEDICINE SYSTEM. Budinger, T. F. (Univ. of California, Berkeley). pp 501-555 of Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol.1); CONF-721017-(Vol.1).

Most digital computer systems interfaced to the gamma-camera and other nuclear medicine imaging devices do not have the speed and spatial resolution appropriate for many clinical and research investigations. Data losses as great as 40% occur during dynamic heart studies, and the gamma-camera spatial resolution cannot be adequately represented by systems with 32 × 32 or 64 × 64 rasters. A system comprising analog-to-digital conversion in 3 μsec with data accumulation in list mode at 82 kHz, and in histogram mode at 300 kHz, is now available for clinical and research studies. Frame rate is 100 per sec in list mode. This disc-operating system uses the Hewlett-Packard 2100A computer (16-bit words) and movable head discs (2.4 million words) with CRT display and light pen for assistance in generating time-activity curves. For the camera the usual acquisition resolution is 128 × 128, but can be 256 × 256. The routine display is 64 × 64, with the ability to present 128 × 128 images. The whole-body scan is represented by six frames (64 × 384) and four isotopes for transmission-emission whole-body isotope quantitation. At one time 160 images and 16 time-activity curves are available for immediate access for display or arithmetic manipulations. Programs implemented on this system with 12 K memory include one- and two-dimensional Fourier transforms, washout or clearance images, and rapid means of adding, subtracting, multiplying, and dividing images or time-activity curves by other images or time functions or by scalers. The system can be operated by a technician or clinician with no prior computer experience. The Anger whole-body scanner consisting of a bed which moves over an array of 64 NaI(Tl) detectors has been interfaced to this digital system as well as the Anger scintillation camera operating at 3 μsec pulse pair resolution. Examples of dynamic and static studies of brain, heart, kidneys, pancreas, and bone are shown, using both conventional display techniques and display of functional images where time and isotope relationships are coded by color. (140 references) (auth)

21247 QUANTITATIVE DISPLAY OF IMAGE DATA AS COMPUTER-CONTROLLED COLOUR-CODED ISOCOUNT CONTOURS. Adams, R. (Loma Linda Univ., CA); Jansen, C.; Braun, E.; Finney, C. pp 557-570 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

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A number of investigators have demonstrated the usefulness of the digital printout of isocount contours, in which certain typed or printed characters are employed to code each isocount level. However, such a display may present too large a volume of data for the clinician to interpret readily. One obvious method to improve

pattern and intensity recognition is to replace the printed characters in each contour level with color-coded dots. The authors have developed a system for producing such color-coded isocontours under computer control. The system includes a series of color filters on a wheel mounted between the lens of an oscilloscope camera and the oscilloscope screen, together with interfacing to the computer. A program written to the authors' specifications enables the operator to write subroutines for the later production of any desired mathematical scale of isocontours and any desired series of corresponding colors. During execution the computer directs the opening or closing of the camera shutter, the selections of color filters, and the display of isocount contours. Each contour is usually photographed in sequence through at least two filters during preselected exposure times. Although most of our color scales employ saturated colors in spectral sequence, it is possible to generate a color scale in contrasting colors of any desired hue, brightness, and saturation by mixing various combinations of red, green, blue, and neutral grey. The authors present scintigrams made with various color scales to show their effect on pattern and intensity recognition as compared with a conventional grey scale. These color scales provide enhanced contrast combined with greatly extended dynamic range and fairly precise quantitative information at a glance. (auth)

21248 ON-LINE SYSTEM FOR SCINTIGRAPHIC DATA. Di Paola, R. (Institut Gustave-Roussy, Villejuif, France); Bazin, J. P.; Parmentier, C.; Todd-Pokropek, A. E.; Tubiana, M.; Zajde, C.; Bosshard, R. pp 571-587 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

An on-line system for scintigraphic data collection, processing, display and long-term storage is described. Based on a Varian 622/i computer with 8 K words of 18 bits and two disks each with 520 K storage capacity, this system allows data collection from a Nuclear Chicago Pho Gamma III gamma-camera either in incremental or sequential mode. The computer-camera interface in use not only takes into account the X and Y co-ordinates, but also energy and physiological data. A variable computer word format permits the user to obtain images of dimensions from 32 × 32 to 256 × 256 and energy sampling from 4 to 256 channels. The software of this system allows fast and simple communication between clinicians and computer. To perform this, not only a teletype, but also a visualization unit and a system including microphones and a system including microphones and a sonic pen are used. A file handling routine, a chaining program and a number of matrix formation, processing, display and storage routines have been written and can be used also for scanner data. (auth)

21249 AUTOMATIC SELECTION OF REGIONS OF INTEREST IN SCINTIGRAPHIC IMAGES. De Graaf, C. N. (Rotterdamsch Radio-Therapeutisch Institut, Rotterdam, Netherlands). pp 589-597 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

Automatic selection of regions of interest within radioisotope distribution imaging studies, such as in dynamic studies, would avoid the need for manual interaction in computerized procedures. Some methods are briefly outlined and one particular new method is described in more detail. Terms introduced are "distinctive height" and "characteristic function." (auth)

21250 COMPUTER DETECTION OF DIFFUSE LESIONS ON BRAIN SCANS. St. Clair Neill, G. D.; Hutchinson, F. (Eastern Regional Hospital Board, Dundee, Scotland). pp 599-612 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

Computer analysis of scintiscans improves the detection of focal lesions, but is less successful with diffuse lesions. One line of approach to the latter problem is to define an "average normal" scan of the organ with which other scans can be compared. This has been done for brain scans, dividing the area of the scan into a number of rectangular cells and finding the average pattern of count distribution. A large proportion of the activity on ^{99m}Tc brain scans is in peripheral regions, and small changes in position or head-shape can alter the count distribution considerably. This leads to a large normal range, and moderately obvious lesions may not be detected. With a contour method of display, any brain lesion will increase the area covered by higher contours and decrease the area of lower contours. This should be unaffected by positioning errors. Fifteen contour levels are selected, and an average normal pattern is again calculated. Results obtained with both techniques on a realistic phantom and on clinical brain scans are presented, and the relative importance of statistical noise, patient positioning errors and variations in head shape are discussed. (auth)

21251 INTERACTIVE PROCESSING AND DISPLAYING OF DIGITAL SCINTIGRAMS. Lorenz, W. J.; Georgi, P.; Meder, H. G.; Pistor, P.; Walch, G.; Wiebelt, H. (German Cancer Research Center, Heidelberg). pp 613-633 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1972).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

A two-stage procedure is presented for digital processing of scintigraphic images. The first stage consists in the application of a linear Wiener filter. Two different types of filters are proposed. The second stage involves a detailed image analysis and an optimization of display parameters using the interactive IBM 2250 display unit. The interactive analysis is described and clinical examples are demonstrated. (auth)

21252 DATA DISPLAY IN SCINTIGRAPHY BY MEANS OF A HIGH-SPEED ELECTROSTATIC DIGITAL PLOTTER AND SPECIAL COMPUTER AVERAGING TECHNIQUES. Jordan, K.; Geisler, S. (Medizinische Hochschule, Hanover). pp 635-652 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

The use of a high-speed digital plotter for displaying scintigrams is reported. Even if this plotter is possibly not the optimum display (e.g., there are only a limited number of shades of grey), it allows a very fast documentation, even in full scale, without the use of photographic methods. Furthermore, the authors have studied the correlations between a given number of counts in a scintigram, a given number of display levels, the distribution of these levels in a desired range, the statistical confidence (factor k), and the smoothing effect of filters (filter factor f), and they have related them by simple equations. The authors have tried to answer the question of the optimum value for the factor k. Finally, these considerations have been confirmed in a first series of experiments with simple smoothing filters. (auth)

21253 FILTERING AND SPATIAL FREQUENCY SPECTRA OF RADIOISOTOPE IMAGES. Takenaka, E. (Tokyo Univ.). pp 653-671 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB/315(Vol. 1); CONF-721017-(Vol. 1).

A Fraunhofer diffraction apparatus with a He–Ne gas laser as light source and spatial filters gives two-dimensional spatial frequency spectra (SFS) and a modified or unmodified reconstructed image simply and instantaneously from a photographic image. A parallel beam of a coherent and monochromatic laser light is diffracted by a 35-mm reduced photographic negative of a radioisotope image and displayed on the focal plane of a condenser lens. The amplitude distribution of the diffraction image corresponds to the Fourier transform of the intensity distribution of the light transmitted by the negative, and hence to the SFSs of the radioisotope image. The SFSs when magnified, may be simply observed or may be recorded photographically or displayed on a TV monitor. This method is very suitable for the processing of radioisotope images. Conventional scintigrams and scinticamera images do not usually contain half tones, while the half tones in photoscan do not correspond to the true radioisotope distribution in the human body. In general, Fraunhofer diffraction gives SFSs with low-frequency components too low in amplitude for the spectra to be clinically unable; this limitation is removed by the use of lenses of very long focal length (up to 6 m). The low-frequency components can then be observed. The SFSs of radioisotope images consist of many spectral components including that for the unstable radioisotope distribution in the human body and components representing scanning line space, dot size and quantum noise. The components for scanning line space and dot size are almost completely removed by low-pass filters. On the other hand, quantum noise is partly generated in the usable radioisotope distribution in the human body and cannot be completely filtered out. By using various spatial filters, however, good reconstructed images can be obtained. This apparatus gives good magnification of the important low-frequency

components of the SFSs of a radioisotope image. The distribution pattern of a radioisotope can be characterized in terms of its SFS, derived from the intensity distribution of the image. A re-evaluation of images in these terms may be useful. (auth)

21254 AUTOMATIC PROCESSING OF SCINTIGRAPHIC IMAGES ON A DIGITAL COMPUTER. Roux, M. A.; Bisset, J. P.; Mourou, M. Y.; Walter, D. O. (Faculte de Medicine, Marseille). pp 673-676 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB/315(Vol. 1); CONF-721017-(Vol. 1).

The proposed method is designed for detecting certain abnormalities that are barely discernible because of statistical fluctuations and electronic background noise, i.e., abnormalities involving hot or cold nodules. The method consists in obtaining first a series of typical images called "standards": each is represented by a matrix of restricted size and displays the activity of a typical nodule. A search is made for the scan area most closely resembling one of these standards by passing each of them, one by one, over the whole of the scan surface. At each scanning stage attention is limited to the submatrix representing a scan area having the same size as the standard. If the activity represented by the elements of the scintigraphic matrix is considered to be a random variable, the method consists in studying simultaneously the observed scan s(i) and the standard p(i). These variables are considered unidimensionally in a line-by-line development of the matrices. This method, which requires a computer, makes it possible to evaluate pathological scintigrams containing images barely visible or invisible to the eye. (auth)

21255 STATISTICAL CONTROL OF VARIOUS SMOOTHING PROCEDURES FOR NUMERICAL SCINTIGRAMS: RESULTS OBTAINED IN MEDICAL PRACTICE. Legras, B.; Martin, J.; Portmann, M. C. (Universitaire de Mathematiques, Nancy, France). pp 677-690 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

The paper concerns control of the smoothing of numerical scintigrams by means of statistical tests. The principle of the statistical tests is as follows: if the smoothed values are a good estimate of the "mean values" (as would be the case in the absence of random fluctuations), then: (a) The sum of the squares of the reduced differences between smoothed values and measured values follows a χ^2 law with n degrees of freedom (n = the number of points); (b) The proportion of measured values higher (or lower) than the smoothed values must average 0.5. To verify this, the authors apply two tests to all and/or a part of the measured and smoothed values. In this way, they can define statistically acceptable smoothing procedures for all or part of the values exceeding specific thresholds. The authors are starting at the present time to apply these methods to medical scintigraphy. They have connected to a scanner a machine which punches on tape the values registered during scintigraphy as well as the anatomical points selected. The data are processed on a CII 10 070 computer. The authors use various programs written in FORTRAN IV, according to the type of smoothing procedure selected and the layout of the documents processed. The results show that statistical tests are effective for picking out the documents corresponding to the most satisfactory smoothing procedure. This point is particularly interesting in the case of successive averagings, where it is found that, depending on the organs concerned, the activity detected at each point and the uniformity of absorption, the tests can be valid for the first, second or third averaging or for none at all. This means of statistical checking, which it may be possible to use on computers with a relatively small central memory, allows better interpretation of the numerical scintigrams processed. (auth)

21256 HYBRID SIMULATION: A NEW METHOD FOR COMPARISON OF SCINTIGRAPHIC DEVICES. Runczik, I. (Postgraduate Medical and Pharmaceutical Inst., Prague); Cernoch, V.; Vavrejn, B. pp 691-704 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. I); CONF-721017-(Vol. 1).

Different scintigraphic devices are usually compared by measuring their parameters (e.g., their resolution, sensitivity, etc.) or by phantom studies. However, to apply these results to a specific clinical situation remains a problem because the real radioactivity distribution in the body cannot be simulated even by a complicated phantom. A contribution to the solution of this problem may be the hybrid simulation method which is described. This method combines the complexity of a real radioactivity distribution with well-defined defects and is based on the perturbation theory. Defined perturbation obtained by the use of a classical phantom is added to a clinical scintigram. The resulting modified scintigram is compared with the original one. The scintigraphic device providing the best visible change in the modified scintigram (for the same perturbation and patient) may be considered as the most suitable one. The method assumes the development of a unified data-handling system. The usefulness of the method is shown in examples obtained with a moving detector scintigraph (Picker Dual Magnascanner V) and an Anger-camera (Nuclear Chicago Pho/Gamma III). (auth)

21257 INVESTIGATION USING MONTE-CARLO TECHNIQUES AND GAMING THEORY INTO THE VALUE OF DIGITAL RADIOISOTOPE DISPLAY SYSTEMS. Todd-Pokropek, A. E. (Inst. Gustave-Roussy, Villejuif, France). pp 705-723 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

In order to optimize scans it is necessary to have a suitable parameter which reflects the quality of the scan. Since this is difficult to obtain analytically, it was thought desirable to use a Monte-Carlo method. In addition, the optimal interpretation of such images depends on an a priori knowledge of positive and negative incidence rates. Weights, as in gaming theory, must also be attached to all possible outcomes. It is hypothesised that much of the value of digital systems is reduced as a result of unsatisfactory display systems. An intercomparison of several such displays was made in the light of the preceding theoretical results. The devices used were: a teletype, a storage tube, a color television, and an electrostatic plotter. With the electrostatic plotter and the storage tube, both of which have only a single intensity level, the display is generally obtained by using a number of "characters" formed from different combinations and concentrations of dots. It has been found that it is impossible to achieve a suitable compromise between the large element size required to give a good grey scale and the small element size needed in order to interpolate. A new display technique is presented, avoiding the use of "characters," for use on a small computer system, allowing both interpolation of the image and a good range of grey scale. (auth)

21258 IAEA CO-ORDINATED RESEARCH PROGRAMME ON THE INTERCOMPARISON OF COMPUTER-ASSISTED SCINTIGRAPHIC TECHNIQUES. pp 727-743 of Medical Radioisotope Scintigraphy, 1972. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintography; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315(Vol. 1); CONF-721017-(Vol. 1).

Work carried out so far under the international Atomic Energy Agency (IAEA) Co-ordinated Research Programme on the Intercomparison of Computer-assisted Scintigraphic Techniques and reported at a Research Co-ordination Meeting for the Programme that took place in conjunction with the IAEA Symposium on Medical Radioisotope Scintigraphy held in Monte Carlo from 23 to 28 October 1972 is described. An initial intercomparison of various data-processing techniques for image enhancement has been completed. This intercomparison was based on the distribution of simulated scan data generated by computer from a mathematical simulation of a simple geometrical phantom into which different patterns of lesions, either hot or cold, could be introduced. Participating institutions were requested to process and display the scan data by their usual techniques, evaluate the processed displays as regards the presence or absence of lesions and return their results to the IAEA. A total of 17 institutions returned results and an analysis of these results is presented. While this analysis does not permit any definitive statement as to the true clinical value of data-processing techniques for image enhancement in clinical situations, some interim conclusions are drawn regarding the relative merits of different processing techniques and the extent to which the results obtained with a given processing technique depend on the choice of display technique and the performance of the observer. These conclusions should be valuable in the design of further intercomparisons now being planned. (auth)

21259 DETECTION OF CHARGED PARTICLES BY POLYMER GRAFTING. Monnin, M. M.; Blanford, G. E. Jr. (Univ. Clermont, Aubiere, France). Science; 181: No. 4101, 743-744(24 Aug 1973).

Tracks of fission fragments from a californium-252 source have been revealed by graft copolymerization. A 15% solution of prope-

noic (acrylic) acid monomer was reacted with irradiated cellulose triacetate for 24 h at 55°C. Copolymer forms preferentially at the track sites and it can be dyed with rhodamine B because of its acid and hydrophylic properties. After the dyeing, the tracks were seen by using fluorescence microscopy. (auth)

21260 MULTIPLE SAMPLE COINCIDENCE COUNTER. Laney, B. H. (to Nuclear-Chicago Corp.). U. S. Patent 3,723,736. 27 Mar 1973. Filed date 11 May 1971. 20p.

In a liquid scintillation coincidence counting apparatus, an improvement wherein multiple radioactive samples are analyzed simultaneously using a counting chamber divided into sections by a partition is described. Each section of the chamber accommodates a sample and is in visual communication with at least two and less than all of the photomultiplier tubes. The coincidence detection system passes electrical pulses only when coincident electrical pulses are received from all of the photomultiplier tubes in visual communication with a single section of the chamber. (Official Gazette)

21261 RADIOGRAPHIC DISPLAY SYSTEM. Colombo, S.; Carugati, V.; Ferramola, G.; Ferrari, S. (to Raytheon Co.). U. S. Patent 3,735,132. 22 May 1973. Filed date 16 Oct 1970. 22p.

A nuclear imaging device comprising a plurality of scanning heads spaced apart in a predetermined configuration with the aid of a support member that permits the individual scanning heads to scan in parallel, antiparallel, and tomographic modes is described. The support member which is driven in both X and Y directions is mechanically connected with the stylus of a graphical Y-Y plotter via a backlash linkage. Displays are provided wherein the color of the ink dot on printed paper or the intensity of the light projected on photographic film is related to the nuclear particle count in a preselectable manner. (Official Gazette)

21262 APPARATUS AND METHOD FOR ADJUSTING GAIN OF PHOTOMULTIPLIER TYPE SCINTILLATION DETECTORS. Bristol, S. M. (to Packard Instrument Co., Inc.). U. S. Patent 3,721,824. 20 Mar 1973. Filed date 10 Apr 1967. 28p.

Photomultiplier type scintillation detectors are normalized, or adjusted to constant gain characteristics, independent of the high voltage applied to the photomultiplier. The normalized photomultiplier circuit is particularly useful in coincidence counting in liquid scintillation spectrometry, especially where the circuit is of the summation type. The inventive system has special application to apparatus for externally standardizing the spectrometer output to compensate for sample quench effects. (Official Gazette)

21263 DIRECTIONALLY SENSITIVE RADIATION DETECTOR SYSTEM USING IONIZATION CHAMBERS. Wall, J. A.; Burke, E. A. (to Secretary of the Air Force). U. S. Patent 3,723,740. 27 Mar 1973. Filed date 29 Apr 1971. 4p.

An x- and gamma radiation detector having two parallel spaced walls composed of materials of significantly different atomic numbers is described. Any suitable sensitive medium between the walls may be utilized so as to produce a larger signal when the lower atomic wall faces the source of radiation than when the high atomic number material faces the source. (Official Gazette)

21264 GAMMA RAY SPECTROSCOPY WITH QUANTITATIVE ANALYSIS. Scott, H. D. (to Texaco Inc.). U. S. Patent 3,739,171. 12 Jun 1973. Filed date 19 Jul 1971. 16p.

An illustrative embodiment of the invention includes methods and apparatus for obtaining gamma ray spectra of earth formations surrounding an open or cased well borehole. Pulsed neutrons of 14 MeV are used to excite the elements around the well bore and a scintillation detector is activated a predetermined time after each pulse from the source to detect gamma rays resulting from the capture in the earth formation of thermalized neutrons from the source. The spectrum of gamma rays so resulting is obtained and compared with a composite spectrum made up of a weighted mixture of standard spectra by the use of the least squares technique. The gain and threshold values of the standard spectra are adjusted and the composite spectra resulting therefrom are again compared with the unknown spectrum and this process repeated until the best possible fit of the standard composite spectrum is obtained. The weights of the standards so obtained are then logged as a function of borehole depth to provide lithology information. (Official Gazette)

21265 RADIATION DETECTING APPARATUS. Spelhs, D. J.; Kreuser, M. J. (to Nuclear-Chicago Corp.). U. S. Patent 3,723,735. 27 Mar 1973. Filed date 1 Feb 1971. 12p.

An improved light guide for use in a scintillation camera or similar apparatus is described. The areas of the surfaces of the light guide not in contact with the photomultiplier tubes or the scintillating crystal assembly are covered with a highly light absorbent coating, such as black paint. In the preferred form, V-shaped indentations extend into the surface of the light guide and encircle the light sensitive faces of the photomultiplier tubes about the periphery thereof. These V-shaped indentations are also coated with a light absorbent coating. This improvement in the construction of the light guide reduces greatly the occurrence of "hot spots", which are recordings in a two-dimensional co-ordinate system of inordinately large concentrations of light that are not actually present at certain spots in the radiation source. (Official Gazette)

21266 CIRCUIT FOR IMPROVING DATA IN PULSE DETECTION SYSTEMS. Culver, R. B. (to Dresser Industries, Inc.). U. S. Patent 3,739,172. 12 Jun 1973. Filed date 24 May 1971. 6p.

A circuit for preventing pulse pileup in the detection of gamma rays from the inelastic scattering of fast neutrons in well logging is described. The amplified pulses from a radiation detector are coupled through a delay line to a linear gate. The amplified pulses from the detector are also connected to a discriminator. The output of the discriminator is AND gated in a logical gate with a clock pulse which is synchronized with a high energy neutron source. The AND gate triggers a single shot multivibrator which in turn triggers the linear gate. The delay line allows for the time required for the detector pulse to rise to the discriminator threshold and for the propagation delay in the logic circuitry. The linear gate opens before the arrival of the detector pulse and closes after it passes through. In this embodiment, any detector pulse having the necessary discriminator level occurring within the clock pulse interval passes through the linear gate as a full width pulse. In an alternative embodiment, a J-K flip-flop circuit is triggered by the trailing edge of the single shot multivibrator to disable the AND gate, thus causing the linear gate to pass only the first detected pulse having the necessary discriminator level. (Official Gazette)

21267 RADIOLOGICAL WELL LOGGING METHODS AND APPARATUS FOR REDUCING THE EFFECT OF ACTIVATION FROM THE DETECTOR CRYSTAL. Arnold, D. M.; Pitts, R. W. Jr. (to Texaco Inc.). U. S. Patent 3,733,486. 15 May 1973. Filed date 30 Dec 1970. 20p.

Improved radioactivity well logging methods and apparatus are provided for determining the macroscopic thermal neutron capture cross section of subsurface earth materials, wherein a correction is made to reduce or eliminate the effects of the portion of the measurement which is due to activation of the crystal in the detector. The high energy neutron source is pulsed at a preselected rate during the first portion of the operating cycle, and the resulting capture-induced radiation is measured within the first portion of the operating cycle during two preselected time intervals following the termination of each neutron burst. Thereafter, the source is inactivated during the balance of the operating cycle, and a measurement is made of the radiations registering in the activated crystal. This latter measurement is then utilized to correct the measurements obtained during the first portion of the operating cycle to a predetermined relationship. (Official Gazette)

21268 DIFFERENTIAL CROSS SECTION DETERMINATION IN EXTENDED GEOMETRY WITH AN INCIDENT PARTICLE CONTINUUM. Overley, J. C.; Ehlers, D. H. (Univ. of Oregon, Eugene). Nucl. Instrum. Methods; 111: No. 1, 13-19(1973).

An algebraic expression for differential cross sections is obtained for experimental conditions which include (1) use of an incident particle energy continuum, (2) measurements of reaction yields as a function of flight time and reaction product energy, and (3) large solid angles. Expressions are also obtained for mean values of geometrical quantities and for standard deviations in these values. The results apply specifically to neutron-induced, charged particle differential cross section measurements, but should be applicable whenever extended geometry of the type considered is encountered. (auth)

21269 GEOMETRICAL PROBLEMS IN THE USE OF ANNULAR DETECTORS. Klein, G. (Univ., Cologne). Nucl. Instrum. Methods; 111: No. 1, 49-52(1973).

In the measurement of absolute or relative cross sections of nuclear reactions in the region of extremely large backward angles using annular detectors, geometrical particle beam characteristics may cause remarkable systematic errors. Their dependences on beam profile, emittance, detector geometry, and analytical behavior of the angular distributions are investigated. A simple beam focusing technique is discussed which (beside other appreciable experimental advantages) is capable of reducing those errors considerably. (auth)

21270 DETECTION EFFICIENCY OF FAST NEUTRON TIME-OF-FLIGHT DETECTORS AND RELIABILITY CHECK BY MEASURING TAILORED SOURCE SPECTRA. Kappler, F. W.; Rusch, D.; Wattecamps, E. D. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 111: No. 1, 83-92(1973).

The efficiency of fast neutron detectors for use in time-of-flight measurements is calculated and checked by spectrum measurements of tailored sources. The standards used in the energy range from 10 eV to 14 MeV are: ^{6}Li-glass below 1 keV, ^{10}B-vaseline slab from 1 keV to 1 MeV, and a NE 213 liquid scintillator above 1 MeV. The choice of these standards results from the investigation of the accuracy of the calculated efficiencies and from the reliability investigations of measured spectra. As parts of the spectrum obtained with each detector are overlapping in broad energy intervals the measurements were used to check or to calibrate detectors. (auth)

21271 MEASUREMENT OF NATURAL ^{14}C WITH A SINGLE-CHANNEL SCINTILLATION DEVICE AT THE INSTITUTE OF GEOLOGY, ACADEMY OF SCIENCES, ESTONIAN SSR. Punning, Ya. M.; Rayamyae, R. (Inst. of Geology, Tallin, USSR). Izv. Akad. Nauk Est. SSR, Khim. Geol.; 22: No. 1, 91-94(1973). (In Russian).

A sample of benzene was specially prepared for use as a scintillator by generating acetylene from Li_2C_2 and water, and then catalytically forming the benzene from the pure acetylene. The scintillator mixture, which included this benzene (90%) with added m-xylene, PPO and POPOP, was transferred to a cuvette in a single-channel device with a photomultiplier. The entire system was shielded from cosmic rays with 50 mm of Pb and 30 mm of Hg. The counting characteristics of the system, the effect of scintillator volume (from 5 to 14 ml), and the standardizing method are explained. (KSW)

21272 SAFETY THROUGH NEW MONITORING EQUIPMENT: AIRBORNE RADIOACTIVITY. Kosmowski, A.; Gebauer, H. Wasser, Luft Betr.; 17: No. 7, 205-208(1973). (In German).

Recent developments in the FRG on new measuring equipment for monitoring the radioactivity of waste gases originating from nuclear power plants are reported. (GE)

21273 SEMICONDUCTOR RADIATION DETECTORS. II. Kuhn, L. (Siemens AG, Erlangen, Ger.). Messtechnik; 80: No. 12, 366-373(1972). (In German).

Part two deals with manufacturing of different types of detectors. Measuring methods with special detectors are described. Finally the p-i-n detector is illustrated explicitly. (GE)

21274 THEORETICAL EXPRESSION FOR THE TEMPERATURE DEPENDENCE OF SENSITIVITY OF NUCLEAR EMULSIONS. Singh, M. (Government Higher Secondary School, Kurukshetra, India); Sharma, A. P. Indian J. Pure Appl. Phys.; 11: No. 2, 130-132(Feb 1973).

A theoretical investigation of the effect of temperature on the latent image formation has been made in order to study the sensitivity in nuclear emulsions. A theoretical relation connecting the number of effective positive holes (n) and the efficiency of operation has been desired. Experimental observations made for all types of charged particles traversing through nuclear emulsions at various temperatures are in agreement with the deductions from the theoretical expression. (auth)

21275 ESTIMATION OF SENSITIVITY CENTERS IN NUCLEAR EMULSIONS. Singh, M. (Government Higher Secondary School, Kurukshetra, India); Chauhan, M. S.; Sharma, A. P. Indian J. Pure Appl. Phys.; 11: No. 2, 127-129(Feb 1973).

In the expression for the calculation of the number of positive holes (effective ionization) available for latent image formation in a silver bromide crystal, the value of a term S which represents the number of sensitivity centers has to be assumed. An estimation of the value of S in the silver bromide crystals of photographic nuclear emulsions has been made using a relation which expresses S as a function of the size of the grain, the crystal lattice spacing and the absolute temperature. It is shown that with an estimation of nearly 2000 sensitivity centers around room temperature, the calculated ionization parameters are found to agree with the experimental observations of Della Corte et al. (Nuovo Cim.; 10: 958(1953)). (auth)

21276 INSTA-GEL AS SCINTILLATION COCKTAIL FOR MEASURING TRITIUM-LABELLED NUCLEIC ACIDS IN SALT SOLUTIONS. Knaelmann, M. (Technische Univ., Hanover). Kerntechnik; 15: No. 5, 214-218(1973). (In German and English).

The scintillation cocktail Insta-Gel is known to be suitable for measuring activities in aqueous solutions. In biochemical work, high molecular weight substances often occur in salt solutions. Experiments investigating the suitability of Insta-Gel for measuring tritium-labeled nucleic acids in salt solutions are reported. The measurements show that the results are affected to some extent by the salt concentration and by the time when the counts are recorded. The counts should be taken some hours after the samples are prepared, and the salt concentrations should be kept as constant as possible. Insta-Gel was found superior to other commonly used methods, especially when the volume of the aqueous samples to be measured is large. (GE)

21277 ELECTRONIC CONNECTION DEVICE FOR THE CONTROL OF RADIATION MONITORS. Girle, H. D. (to Graetz KG). German Patent 1,937,967. 4 Feb 1971. Filed date 25 Jul 1969. (In French).

21278 PROCESS FOR CONTROLLING THE OPERATION SAFETY OF RADIATION MONITORING AND MEASURING DEVICES. Girle, H. D. (to Graetz KG). German Patent 1,937,966. 4 Feb 1971. Filed date 25 Jul 1969. (In German).

A voltage regulator for the power supply of a radiation detector is described. (WHK)

21279 SATURATION CHARACTERISTICS OF A BORON-LINED IONIZATION CHAMBER. Chae, S. K. (Korea Inst. of Sci. and Tech., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 94-102(Jun 1973).

Saturation characteristics of a current-type ionization are investigated theoretically and experimentally in the columnar recombination region. The experiments were performed using a boron-lined cylindrical ionization chamber filled with nitrogen or helium at pressures of 760 mm Hg and 380 mm Hg. The collection efficiency deduced from the analytical method is in good agreement with the experimental results. This theory makes it possible to predict saturation characteristics for all ionization intensities with only the design data. (auth)

21280 DISTRIBUTIONS OF ELECTRIC FIELD AND CHARGE DENSITIES IN A PARALLEL-PLATE IONIZATION CHAMBER. Hyun, K. H.; Chae, S. K. (Korea Inst. of Sci. and Tech., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 132-136(Jun 1973).

Uniformly irradiated parallel-plate ionization chambers filled with a gas free of negative ion-forming contaminants was studied. Computer solutions for the electric field and the positive and negative charge densities at various degrees of saturation were obtained and discussed. (auth)

21281 CALIBRATION OF PLASTIC NUCLEAR TRACK DETECTORS FOR IDENTIFICATION OF HEAVY CHARGED NUCLEI USING FISSION FRAGMENTS. Endo, K. (National Lab. for High Energy Physics, Ibaraki, Japan); Doke, T. Nucl. Instrum. Methods; 111: No. 1, 29-37(1973).

A method for measuring the variation of the etching rate as a function of the ionization rate for the plastic nuclear track detector using fission fragments is described. In the method, the ^{235}U fission fragments are used as energetic heavy ions for the track formation. The relation between the etching rate and the ionization rate for the polycarbonate film is obtained using the fission fragments kinematically identified and the most probable fission fragments, respectively. Both results are in good agreement. Also, the relation for the cellulose triacetate film obtained using the most probable fission fragments is in good agreement with that obtained using nitrogen ions from a cyclotron. The energy loss region where this method is applicable is $(0.5-7) \times 10^{4}$ MeV cm^{2}/g. Some applications of the calibration curves to particle identification are also shown. (auth)

21282 EFFECT OF THE SURFACE ON THE PHOTO VOLTAGE APPEARING IN THE p-i-n-SEMICONDUCTOR STRUCTURE AT SCANNING OF POINTS. Vasilev, V.; Khinkov, V. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 23: 15-24(1973). (In Bulgarian).

The theory for the appearance of a photovoltage in p-i-n silicon detectors for nuclear radiation upon scanning with an optical microprobe was previously considered. It is reported that in many cases the experimental curves for this voltage differ from the theoretical ones, which is ascribed to the appearance of a surface layer with n- or p-conductivity in the i-area. A detailed model for formation of canals on the p-i-n-semiconductor structure is proposed. A further development of the theory, which renders a possibility for giving an account of the effect of the canals on the shape of the photovoltage curves, is made. (auth)

21283 CHARACTERISTICS OF A CONVERGING COLLIMATOR. Tamiya, T. (Nagoya Univ., Japan); Kasahara, F.; Saito, H. Radioisotopes (Tokyo); 22: No. 5, 243-246(May 1973). (In Japanese).

To enlarge scintillation images to take transmission scintiphotos and to take x-photos exactly superimposable onto the image for its localization in relation to the internal organs, a converging collimator having 1260 holes and 56 cm focus was fabricated. The characteristics of the collimator in magnification, resolution, sensitivity, and the effect on gamma-ray spectrum were tested by placing a ^{203}Hg enclosed line and area source in air and water at various collimator-to-source distance. Scintillation image was recorded in detail by magnification with the converging collimator. The resolution was better than the image with parallel

and diverging collimators, but not the pin-hole collimator. Sensitivity was best among these collimators. With the converging collimator, the count rate was highest at the photopeak area, and the count rate ratio of photopeak to Compton area was largest both in air and water. (auth)

21284 FAST PULSE-HEIGHT RATIO CIRCUIT. Tanaka, E. (National Inst. of Radiological Sciences, Chiba, Japan); Yamamoto, M.; Simadjaja, H. Radioisotopes (Tokyo); 22: No. 4, 161-164(Apr 1973).

A fast pulse-height ratio circuit suitable for position sensitive radiation detectors is described. The circuit is based on the linear to logarithmic conversion method using three semiconductor diodes. By flowing constant standing current through these diodes in quiescent state, the circuit performance is, in principle, independent of temperature. The accuracy of the circuit is almost less than ±1.5% of full scale for input voltage range of 20 to 420 mV at a temperature between 0°C and 50°C. (auth)

21285 FUNDAMENTALS OF SCINTILLATION COUNTING. Cradduck, T. D. (Toronto General Hospital). Semin. Nucl. Med.; 3: No. 3, 205-223(Jul 1973).

The design, operation, performance, and optimization of scintillation detectors are reviewed. (38 references) (WDK)

21286 CARE AND FEEDING OF MEDICAL NUCLEAR INSTRUMENTATION. Harris, C. C. (Duke Univ., Durham, NC). Semin. Nucl. Med.; 3: No. 3, 225-238(Jul 1973).

Medical nuclear instrumentation is sufficiently subject to infirmities and malfunctions that proper maintenance and handling of such equipment is of major importance. Machines respond to many of the comforts and prerequisities considered good for people. For example, when an instrument "comes into the world" (installation) its longevity and good performance depend, in part, on a proper installation. Instruments, like humans, need cool clean air and a healthful environment. By the same rules that guide people into good living habits, good operating principles will improve the effectiveness of instruments. Finally, when illness strikes, prompt diagnosis and efficacious therapy are as indicated for instrumentation as for people. Application of these principles by concerned and knowledgeable users of medical nuclear instrumentation will improve the chances that the instrumentation will properly serve the patient. Further, these considerations will enhance the likelihood of successful and accurate diagnosis. (auth)

21287 PERFORMANCE ANALYSIS OF IMAGING SYSTEMS. Aronow, S. (Massachusetts General Hospital, Boston). Semin. Nucl. Med.; 3: No. 3, 239-257(Jul 1973).

The ultimate performance test of an imaging system is its medical utility. This requires clinical use and evaluation of how well the system improves the delivery of health care. The radioactive source and the medium through which it travels, the collimator, detector electronics, and display system, comprise the major components that must be calculated in judging any imaging system. The subjective role of the observer and clinical physician interpreting and utilizing the information also must be considered in the overall scheme. A variety of qualitative and quantitative methods exist for analyzing the performance of imaging systems. Detectors deal with three interrelated properties which are resolution, sensitivity, and observation time. Sensitivity measurements deal with counts per unit time obtained from a point or planar source placed a specific distance from the face of the detector system. Resolution measurements deal with the ability to discriminate between adjacent point or line sources. Full width at half maximum and modulation transfer function measurements of resolution are discussed in detail. Various types of geometric absorption, and anatomical phantoms are available to assist in making these determinations. In this review, attention is mostly drawn to the instrumental aspects of the system, since these are reasonably understood and somewhat controllable. However, the elements at opposite ends of the system, the biological mechanisms in the patients body, and the human observer using the information are really the most important, if least understood and controllable elements. (auth)

21288 COLLIMATION FOR RECTILINEAR SCANNERS AND CAMERA IMAGING EQUIPMENT. Kenny, P. J. (Mt. Sinai Medical Center, Miami, FL). Semin. Nucl. Med.; 3: No. 3, 259-266 (Jul 1973).

Collimators are necessary components for imaging systems in order to determine the initial directions from which the gamma-ray photons incident on the detector originated. They help determine sensitivity, spatial resolution, and depth of field. Straight bore (flat field) collimators offer the highest sensitivity but have limited resolution. They are best used for counting studies, such as a thyroid uptake, rather than imaging studies. Focused collimators are used on moving scanners. Optimal resolution and sensitivity is achieved at the focal length where the projections from all of the tapered angulated holes meet at a single point some fixed distance from the front face of the collimator. Most stationary camera detectors used parallel hole collimators where resolution and sensitivity are greatest at the face of the collimator. Pinhole divergent and convergent collimators are available to fulfill certain specific needs present in clinical imaging. In general, modifications designed to improve resolution must sacrifice sensitivity to achieve it. The converse is also true. For this reason, commercially available instruments offer a variety of collimators with which the physician utilizing the equipment must familiarize himself. (auth)

21289 RADIONUCLIDE TOMOGRAPHY. Freedman, G. S. (Yale Univ., New Haven). Semin. Nucl. Med.; 3: No. 3, 267-283 (Jul 1973).

Radionuclide tomography has been developed as a means of improving image planar specificity and resolution. Numerous types of systems designed for this purpose or with this inherent capability are in various stages of development. Some exploit cababilities of existing gamma cameras to which attachments and modifications are added. Others are specially designed to produce either longitudinal or transverse tomograms in single or multiple planes simultaneously. A few utilize positrons or excitation photon emission to improve planar specificity. Sophisticated laser beam or computer image reconstruction methods have also been introduced to eliminate data overlying or underlying the plane of interest. Several of these systems are already in clinical use and preliminary data establish their ability to locate and characterize a lesion not detectable by conventional means. This appears to be especially true for hepatic lesions. While several longitudinal tomographic systems can better characterize brain lesions, it is uncommon to be able to detect a lesion not previously seen by conventional imaging. Transverse tomographic imaging appears clearly superior for imaging the brain, particularly for lesions at the base of the skull, which can not be detected by other means. It must be recognized that these tomographic methods are in their infancy. It remains to be determined how other methods, clinical circumstance, and economic factors will determine the frequency of use and rate of growth of this form of image improvement. This review summarizes the current status of tomography in nuclear medicine. (45 references) (auth)

21290 FACTORS AFFECTING THE COLLECTION AND ANALYSIS OF RADIOTRACER IMAGES. Brill, A. B.; Erickson, J. J. (Vanderbilt Univ., Nashville). Semin. Nucl. Med.; 3: No. 3, 285-300(Jul 1973).

The factors that should be considered in the choice of instrumentation for various clinical imaging situations are reviewed. Imaging systems used in nuclear medicine can be classified according to the relative sensitivity and resolution of the specific system. Most systems currently available have adopted a relatively low sensitivity in an effort to achieve relatively high resolution. Some of the problems encountered which may result in image distortion include count rate losses due to dead time and spatial distortion due to variations in sensitivity and linearity as the photon source moves across the detector. In addition, various problems in temporal resolution also are encountered and these are described in detail. The requirements for the performance of static and dynamic function studies are frequently quite different. In the static study a high resolution image is required and there is a relatively small limitation in the time which may be devoted to the study. On the other hand, a dynamic function study may require the collection of data at extremely short intervals of time which may necessitate the sacrifice of resolution for increased sensitivity. Because of the inherent nature, design, and performance of the machines, there are significant differences in the suitability of the Anger camera and the Autofluoroscope for various studies. These differences are compared and contrasted, and the factors which influence the way in which data are collected and processed are enumerated. (auth)

21291 PHOTOMULTIPLIER SINGLE PHOTON COUNTING EFFICIENCY. Birenbaum, L.; Scarl, D. B. (Polytechnic Institute of Brooklyn, Brooklyn, New York 11201). Appl. Opt. 12: No. 3, 519-521 (Mar 1973).

AN RCA C31000F (8853) photomultiplier with a cathode quantum efficiency of 5.5% (for 633-nm light) was found to have a single photon counting efficiency of only 3.3%. The difference is shown to be due to small pulses well below the single electron peak in the output pulse height spectrum. These pulses are usually below the discriminator threshold level and are not counted. The reason for the small pulses is not understood. (auth)

21292 COLLIMATOR OF MULTIPLE PLATES WITH AXIALLY ALIGNED IDENTICAL RANDOM ARRAYS OF APERTURES. Hoo-

ver, R. B.; Underwood, J. H. (to National Aeronautics and Space Administration). U. S. Patent 3,749,911. 31 Jul 1973. Filed Date 30 Jun 1970. 6p.

A collimator is disclosed for examining the spatial location of distant sources of radiation and for imaging by projection, small, near sources of radiation, the collimator consisting of a plurality of plates, all of which are pierced with an identical random array of apertures. The plates are mounted perpendicular to a common axis, with like apertures on consecutive plates axially aligned so as to form radiation channels parallel to the common axis. For near sources the collimator is interposed between the source and a radiation detector and is translated perpendicular to the common axis so as to project radiation traveling parallel to the common axis incident to the detector. For far sources the collimator is scanned by rotating it in elevation and azimuth with a detector to determine the angular distribution of the radiation from the source. (Official Gazette)

21293 SCINTILLATION CRYSTAL WITH REFLECTION INHIBITING MATERIAL AND SCINTILLATION DEVICE EMBODYING THE CRYSTAL. Martone, R. J. (to Picker Corp.). U. S. Patent 3,745,359. 10 Jul 1973. Filed Date 22 Mar 1971. 6p.

A scintillation camera is described which includes an input phosphor, for producing scintillations in response to gamma rays and like radiation, in the form of a sheet of photofluorescent material having a wedge-shaped peripheral surface coated with a substantially non-reflective material to reduce the amount of light reflected from the peripheral surface. (Official Gazette)

21294 RADIATION CIRCUIT RADIATION DETECTOR. Paul, B. (to Siemens Aktiegesellschaft). U. S. Patent 3,745,360. 10 Jul 1973. Priority Date 21 Mar 1969. F. R. Germany. 6p.

A radiation detector for sensing radiation having a plurality of radiation-sensitive resistances arranged in a bridge circuit, the latter being formed from a crystal so as to be a monolithic entity, is described. The crystal consists of a material having a resistivity sensitive to radiation, whereby the bridge circuit becomes electrically unbalanced when a portion of the resistances is placed in the path of the radiation. (Official Gazette)

21295 NEUTRON DETECTOR. O'Boyle, M. J.; Nodvik, R. J. (to Westinghouse Electric Corp.). U. S. Patent 3,742,274. 26 Jun 1973. Filed date 4 Feb 1971. 4p.

A detector of the fission chamber type having a regenerative coating of ^{238}Pu, or its target material ^{237}Np in conjunction with ^{238}Pu, as a fertile isotope in combination with other fertile, fissile, or fissionable isotopes is described. More particularly such a detector may comprise a miniature in-core fission chamber for nuclear reactors employing such coatings. (Official Gazette)

21296 METHOD AND APPARATUS FOR A SEMICONDUCTOR RADIATION DETECTOR. Meuleman, J. (to U. S. Phillips Corp.). U. S. Patent 3,742,215. 26 Jun 1973. Priority date 26 Jan 1970, France. 4p.

A semiconductor detector and method of fabrication is described. The detector comprises a semiconductor crystal having two outer regions of opposite conductivity types and separated by an intermediate, intrinsic region and each having a recess; these recesses are located opposite each other and have substantially similar configurations. One recess serves as an entrance window for the radiation and has a depth at least equal to the thickness of the outer region concerned, whereas contacts are made at the peripheries of said outer regions. The depth of the recess opposite that serving as an entrance window for the radiation is at least equal to the thickness of the outer region in which it is provided. (Official Gazette)

21297 SCINTILLATION CAMERA WITH IMPROVED RESOLUTION. Jaszczak, R. J. (to G. D. Searle and Co.). U. S. Patent 3,752,981. 14 Aug 1973. Filed date 10 Mar 1972. 8p.

An Anger-type scintillation camera system fitted with a gamma ray filter between the object under study and the detector and an output signal filter of the signal funneling type which employs a non-linear array of signal filter windows to compensate for inherent non-linear spatial response characteristics in the camera system is described. (Official Gazette)

21298 TOMOGRAPHIC SCINTILLATION CAMERA WITH IMPROVED RESOLUTION. Jaszczak, R. J. (to G. D. Searle and Co.). U. S. Patent 3,752,982. 14 Aug 1973. Filed date 23 Feb 1972. 6p.

An Anger-type scintillation camera employing a rotating slanted channel collimator and associated circuitry to produce a tomographic imaging capability and also employing a scanning radiation filter and associated signal filtering circuitry to improve the resolution of the tomographic imaging is described. Circuitry at the output of the camera corrects the detector output signals before they are processed by the signal filtering circuitry to eliminate the effect of apparent circular precession of passageways in the radiation filter caused by rotation of the collimator. After signal filtering, the effect of apparent circular precession of the radiation filter passageways is reintroduced either by separate circuitry before processing by tomographic camera circuitry or by tomographic camera circuitry adapted to allow for the earlier signal correction. The system may employ the rotating collimator alone or in conjunction with a bed which processes in a circle. (Official Gazette)

21299 RADIATION IMAGING DEVICE. Muehllenhner, G. (to Nuclear-Chicago Corp.). U. S. Patent 3,745,345. 10 Jul 1973. Filed date 9 Nov 1971. 8p.

An Anger-type camera having a photomultiplier tube array mounted on a glass cover of crystal assembly to be about one-half inch from a top surface of the scintillation crystal is described. Non-linear spatial response is measured at points on the crystal defining an array to determine correction factors at measurement points. Correction factors are stored and employed to correct output signals from the camera either on a one-event-at-a-time basis or after an uncorrected map has been stored in the core memory in a digital data system. (Official Gazette)

21300 FUNDAMENTAL DATA OF HITACHI SCINTILLATION CAMERA. 1. Uniformity. Ottomo, M. (Aomori Prefectural Central Hospital, Japan); Takekawa, S.; Takahashi, M.; Noda, M.; Kudo, T. Aomori Kenritsu Chuo Byoin Ishi; 17: No. 3, 254-272 (Sep 1973). (In Japanese).

The Hitachi RC-IC-1205 type scintillation camera was introduced and its uniformity was studied by means of a 400 channel analyzer. First, uniformity was examined macroscopically by using Polaroid photographs and both of ^{57}Co low-energy gamma rays and ^{131}I high-energy gamma rays showed satisfactory uniformity. In the experiment using a 400 channel analyzer, the following items were investigated: (1) distribution of background energy, (2) distribution of energy when gamma-rays strike nineteen pieces of photomultipliers equally in setting ^{57}Co spot radiation source 1.3 m away, and (3) distribution of energy of each photomultiplier when setting ^{57}Co spot radiation source just above photomultiplier. The number of peak channels of energy distribution (2) was compared with energy distribution (3) and these are discussed. Energy resolving power was also calculated. Moreover, by making slits separately in direction of the x axis or y axis, continuous uniformity in the direction of the x or y axis was studied. The number of peak channels of (2) was 238 channels. The mean peak channel number of (3) was 237 channels with a range of 240 to 235, and there was a difference of one channel as compared to the whole. The mean energy resolving power of (3) was 17.5% with a range of 18.0 to 16.6 as compared to 17.6 of (2). The experiment on uniformity by slit showed uniformity within ±8.8% in the direction of the x axis and ±10% in the direction of y axis when effective visual field was 24 cm. (JA)

21301 RESOLVING POWER OF ELECTRON MICROSCOPE AUTORADIOGRAPHY FOR α-EMITTERS. Chernikov, V. N.; Zakharov, A. P.; Duk'yanovich, V. M. At. Energ. (USSR); 33: No. 3, 775-776(Sep 1972). (In Russian).

This paper was summarized as paper No. 609/6781 with full copy held by TIC.

A combination of high autoradiographic resolution and sensitivity and the possibility of studying the surface of the specimen simultaneously with the aid of the electron microscope as the typical feature of the method of electron-microscopic autoradiography. To date, theoretical and experimental research in this area has been restricted to dealing with the effective use of preponderantly soft-emitters. Calculations are used to show that the procedure of electron microscopic autoradiography is superior to its resolving power to the method of analysis based on recording tracks of α-particles in thick emulsion detectors and in other layer type detectors, when the use of α-active isotopes is involved. Digital computers were employed to analyze the functional relations between the photographic density D (density of distribution of crystals of reduced silver) in ultrathin layers of a fine-grained nuclear emulsion placed above the α-active source of interest, and the distance x to that source. The sources in question formed a semi-infinite straight line and a semi-infinite plane oriented in the test specimen at right angles to the surface of the specimen, and a point source and spherical sources of different diameters set at different depths in the specimen. In all cases, the minimum distances at which two photographic densities could still be resolved were calculated on the basis of the criterion used. The effect of such factors as the free path length of the α-particles, the thickness of the emulsion layer and the thickness of the carbon layer, the geometry of the source proper, and the pattern in which the source was arranged within the specimen, and also the nonuniformity of the distribution of radioactive isotope throughout the

depth of the source (in the case of the semi-infinite straight line and semi-infinite plane), on the shape of the D = D(x) curves and accordingly on the resolving power, was calculated. The numerical results of these calculations make it possible to arrive at a priori estimates of the effectiveness of applying that method, or several other nonphotographic methods, to the task without having to resort to additional experimentation, and also make it possible to interpret the resulting data correctly. (auth)

Radiation Dosimeters

Refer also to abstracts 21522, 21731, and 23488.

21302 (AD-761030) IMPROVEMENT OF TEST MODELS OF TACTICAL DOSIMETERS IM185 AND IM188: ACCOMPLISHMENTS AND PROPOSED CONTINUATION OF WORK. Kronenberg, S.; Hempen, R. (Army Electronics Command, Fort Monmouth, N. J.). Apr 1973. 28p. (ECOM-4113). NTIS.

Tactical dosimeters IM185 (Army version) and IM188 (Air Force version) are used to measure total doses of gamma rays and fast neutrons delivered at low rates as well as at extremely high rates. Techniques developed to alleviate the difficulties encountered in the use and maintenance of previous test models are described. The problems included electrical leakage of the electrometer quartz fiber insulator, especially after irradiation with gamma rays, outgassing of hydrogenous materials incorporated in the vacuum chamber of the instrument particularly after irradiation, and difficulties with the charging switch. Also reported are approaches to change sensitivity of the instruments in order to adapt them to Air Force requirements. (auth)

21303 (CEA-N-1085) IRRADIATION DOSIMETRY OF STEELS: TRITON PERIPHERY. Cance, M.; Genthon, J.-P.; Labrousse, M.; Le Tanno, C.; Morin, C.; Thierry, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1973. 14p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Two types of neutronic measurements were carried out at the sites where steels were irradiated in the Chouca and Hebe furnaces at the periphery of Triton. The measurements were made with a view of determining the spectral indices characterizing the flux damaging the steels. A semi-empirical method was used to measure the epithermal flux/fast flux and In equivalent fast flux/Ni equivalent fast flux ratios. Another method, using a graphite detector, was developed for the measurements. This detector complements the results obtained with Ni detectors and leads to a value for the spectral index: equivalent graphite flux/equivalent Ni flux. This new method was found to be more reliable, more accurate, and better adapted to the measurement. (FR)

21304 (COO-1105-182) THREE YEAR REVIEW OF SOLID STATE NEUTRON DOSIMETRY RESEARCH AT THE UNIVERSITY OF WISCONSIN, NOVEMBER 1970–JULY 1973. Moran, P. R.; Cameron, J. R. (Wisconsin Univ., Madison). Jul 1973. Contract AT(11-1)-1105. 19p. Dep. NTIS $3.00.

Research progress in the following areas of neutron dosimetry is reviewed. (A.) Fundamental studies. Low temperature TL studies show a usefulness of cryotemp TL in fast neutron dosimetry by radioactivation methods. They also suggest theoretical interpretations which are currently being followed up by other research groups. Electron Spin Resonance and Stark Effect measurements are used to identify the behavior and character of low-level radiation damage defect states. (B.) Other Applications and Instrumentation. Optical repopulation of TL provides a good uv dosimetry technique. Phototransistor optical detectors can be superior to photomultiplier detectors in TL reader applications where simplicity and stability are more important than high sensitivity. An unexpected discovery of the "tritium-LiF effect" shows promise as a new sensitive method for tritium exposure measurements. This new application has been disclosed to the USAEC patents division in "A LiF TL Device for Tritium Activity Measurements." (C.) New Approaches for Fast Neutron Dosimetry. Rayleigh scattering, Raman scattering, direct ERR free-radical detection, and exciton fluorescence changes in hydrogeneous materials all have been studied and evaluated. Although each is useful for certain special purposes, especially the exciton-fluorescence changes, none shows real potential for personnel level fast neutron dose levels. The method of Fast Neutron Fluence by Radioactivation of Phosphors has been reported as a patent disclosure to the USAEC. This technique does show good promise to date. Recently discovered RITAD/RITAP effects have been examined also for their usefulness in neutron dose measurements. (D.) Other Phenomena. Systematic studies of other radiation induced thermally activated charge transport effects have been carried out. The potential of RITAD/RITAP phenomena for new highly sensitive dosimetry techniques is firmly established. Related, but radiation independent, polarization effects are also useful. An example is, A Bi-Linear Transient Response, Schottky-Voltage Response, Temperature Programmed Capacitor Element, recently disclosed to USAEC Patents Division. (auth)

21305 (COO-1105-183) SUMMARY OF RESEARCH PROGRESS IN SOLID STATE NEUTRON DOSIMETRY, 1972–73. Moran, P. R. (Wisconsin Univ., Madison). 1973. 5p. Dep. NTIS $3.00.

Research during 1972 to 1973 is summarized in five areas related to solid state dosimetry: study of radiation induced thermally activated polarization and depolarization (RITAP/RITAD) effects; solid state fast neutron radioactivation dosimetry; tritium dosimetry; electret phenomena; and electron spin resonance and TL effect. The primary effort of the radiation dosimetry group at the University of Wisconsin has evolved over the past three years toward research on the problem of solid state integrated fast neutron dosimetry. Although work has continued in studying applications of TL, the major thrust is now investigation of new techniques hopefully more suitable for neutron dosimetry. Some older techniques are known and have reasonable potential: TSEE with proton radiator recoil films, fission foil radiators—etched track detectors, thermalization and capture in (^{6}LiF/^{7}LiF) TLD materials, silicon p–i–n diode response. It was decided that development studies of these methods are already in very good hands, and that research should stress newer and even less well known phenomena. (auth)

21306 (COO-1105-188) PHOTON COUNTING SYSTEM FOR THERMOLUMINESCENT DOSIMETRY. Lasky, J. B.; Pearson, D. W.; Moran, P. R. (Wisconsin Univ., Madison. Dept. of Physics). [nd]. 7p. Dep. NTIS $3.00.

A photon counting system has been assembled for use in thermoluminescent dosimetry which will permit an order of magnitude improvement in signal-to-noise over dc techniques. Advantages of photon counting over dc techniques and considerations in the selection of photo cathodes are discussed. (auth)

21307 (COO-1105-201) HIGH-TEMPERATURE RITAD DOSIMETRY. Fullerton, G. D.; Moran, P. R. (Wisconsin Univ., Madison). 1973. 8p. Dep. NTIS $3.00.

Work in progress in search of a practical radiation induced thermally activated depolarization dosimeter (RITAD) is reported. The work of Podgorsak and Moran on CaF_2 holds much promise but the material is not useable at room temperature because of the low peak temperatures. The temperature range of the equipment used in the original RITAD experiments were extended to 500°C and a survey of high-purity crystalline TL and TSEE materials was implemented. High-temperature electret states have been observed in BeO ceramic and in crystalline Al_2O_3 which is encouraging. A strong RITAD effect has not been observed in these samples. Higher purity samples of these materials as well as other materials will be investigated. (auth)

21308 (COO-1105-202) MONOGRAPH ON LUMINESCENCE DOSIMETERS, CONDUCTION DOSIMETERS, AND POLARIZATION DOSIMETERS. Moran, P. R. (Wisconsin Univ., Madison). [nd]. 12p. Dep. NTIS $3.00.

An important physical distinction exists between conductance and polarization dosimeters. This implies differences in the manner of construction of devices utilizing the two effects. Limiting sensitivities depend upon the quantum nature of the incident exposure. RITAP/RITAD (Radiation Induced Thermally Activated Depolarization and Radiation Induced Thermally Activated Polarization) device construction is discussed. (auth)

21309 (DP-MS-72-72) ADVANCES IN PERSONNEL NEUTRON DOSIMETRY. Hoy, J. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 20p. (CONF-721209-3). Dep. NTIS $3.00.

From health protection meeting; San Juan, Puerto Rico (8 Dec 1972).

Three aspects of personnel dosimetry are discussed: (1) reasons why neutron dosimetry of personnel has not progressed as fast as gamma dosimetry, (2) types of personnel neutron dosimeter that are currently in use, and (3) dosimetry systems being investigated for future use. (TFD)

21310 (LA-5261) A SMALL, INEXPENSIVE ALBEDO-NEUTRON DOSIMETER. Hankins, D. E. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

A small (1¼ by ¾ by ⅜ in.) albedo-neutron dosimeter that can be worn by taping it to the bottom of the existing film badge is described. It can be made in a workshop without special equipment r training in about one hour from cadmium and polyethylene sheets t a materials cost of about 25 cents excluding the thermoluminescent dosimeters (TLD's). It was designed to use ^{6}Li- and ^{7}Li-TLD chips, although other types of ^{6}Li and ^{7}Li TLD's could be used. The neutron dose is determined by subtracting the ^{7}Li reading from the

^{6}Li reading and applying the appropriate calibration factor. The dosimeter's thermal-neutron sensitivity (in rems) is equal to its sensitivity to fast neutrons of about 1-MeV energy. The dosimeter is very energy dependent, having the same energy dependence for fast neutrons as other albedo-neutron dosimeters. Two calibration procedures for field use are described, one using a gallon jug and the other a 9-in. cadmium-loaded remmeter and a 12-mil cadmium-covered 3-in. sphere. Any type of TLD reader can be used because the TLD readout is not automated. For low-neutron doses, or if a high accuracy is desired, the dosimeter can be used with up to eight TLD's (four ^{6}Li and four ^{7}Li chips). (auth)

21311 (LBL-2057) PERSONNEL NEUTRON DOSIMETRY STUDIES AT THE LAWRENCE BERKELEY LABORATORY. Thomas, R. H. (California Univ., Berkeley. Lawrence Berkeley Lab.). 12 Jun 1973. Contract W-7405-eng-48. 5p. (CONF-730647-2). Dep. NTIS $3.00.

From USAEC personnel neutron dosimetry workshop meeting; Miami Beach, Florida, USA (14 Jun 1973).

The importance of personnel neutron dosimetry around high-energy accelerators is discussed and neutron dosimetry studies at Berkeley are outlined. Neutron track film, thick emulsions, and shielded and moderated BF3 counters are briefly discussed. (WHK)

21312 (ORNL-TM-4297) LONG-TERM STABILITY OF FILM, TLD, AND OTHER INTEGRATING DOSIMETERS IN WARM AND HUMID CLIMATES. Becker, K. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 87p. Dep. NTIS $6.50.

With the increasing use of radiation source in hot and/or humid climates, the long-term stability of dosimeters selected for personnel, environmental, and postal intercomparison dosimetry is becoming a matter of world-wide concern. Laboratory tests with various film, TLD, RPL (glass), silicon diode, TSEE and track etching dosimeters at ORNL and other laboratories are reviewed and compared with the results of field tests, in particular a recent study involving the storage of different gamma monitoring films with or without additional protective sealing, LiF: Mg, Ti (TLD-100), and $CaSO_4$: Dy at seven locations in four Latin American countries. The observed fading rates range from 0 to 100% for the Kodak Type 2 and 3 films, and from 0 to 23% for the TLD phosphors, depending on the climate of the location. In four of the seven locations, unsealed films should not be used in X- and gamma-radiation personnel dosimetry (in two of those places, even optimum sealing did not prevent 54 to 89% fading). Extremes in storage temperature are most critical for TLD, extremes in relative humidity for the film fading. The results and the consequences to be drawn are discussed. Apparently, even carefully sealed dosimeter films cannot be used in the climate prevailing at many locations. Some desirable follow-up studies are outlined. (auth)

21313 DEVICE FOR MEASURING AN IONIZING RADIATION. Schwaar, L. (to Veb Rft Messelektronik Dresden). German Patent 1,303,191. 6 May 1971. Filed Date 2 Jun 1960. (In German).

A method for measuring radiation dose based on using a detector with an absorber and a detector without an absorber is described. (WHK)

21314 ABSOLUTE COUNTING OF K X RAYS FROM ^{103m}Rh IN THICK FOILS. Ing, H.; Cross, W. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 437-450(Aug 1973).

For the purpose of measuring neutron flux or dose using the $^{103}Rh(n,n')\ ^{103m}Rh$ reaction, the fraction of Rh K x-rays escaping from foils of various sizes and detected by a thin NaI(Tl) crystal at different counting geometries was calculated and supported by experiments. Also, the number of K x-rays emitted per ^{103m}Rh decay was measured to be 0.0703 ± 0.0044. Equations and graphs are presented so that the relationship between the counting rate of 20-keV x-rays and the ^{103m}Rh transition rate can be determined easily for practical counting systems. (auth)

21315 PORTABLE β/γ SPECTROMETER FOR CHECKING FOODSTUFFS FOR RADIONUCLIDE CONTAMINATION. Frank, A. (Inst. fuer Strahlentechnologie, Karlsruhe, Ger.). I-T (Glas-Instrum.-Tech.) Fachz. Lab.; 17: No. 6, 581-582(1973). (In German).

21316 CALORIMETRIC MEASUREMENT OF IONIZING RADIATION. 5. Absorbed Dose of ^{137}Cs Gamma Rays and Electrons from Betatron. Sakata, S. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 7, 619-625(Oct 1972). (In Japanese).

A measurement of the ratio of absorbed dose in a carbon calorimeter to ionization in a carbon ionization chamber exposed to ^{137}Cs gamma-rays and electrons from a betatron with the initial energy of 15 and 25 MeV is described. The calorimeter is of the twin isothermal type with a thermistor as the temperature sensitive element. The chamber was designed to be similar in shape to the calorimeter so that the ionization at a point of carbon corresponds to the absorbed energy measured by the calorimeter at the same point. With ^{137}Cs gamma-rays, the stopping power ratio of carbon to air was calculated to be 1.011 from the ratio of absorbed dose to ionization assuming that W = 33.73 per ion pair. The stopping power ratios for electrons at various depths in carbon were obtained using mean electron energies which were derived from Harder's formula. The agreement between experimental and theoretical values is reasonably good. (auth)

21317 EXOELECTRON EMISSION DOSIMETERS. Becker, K. H. (to United States Atomic Energy Commission). Australian Patent 416,229. 30 Jul 1971. Priority date 23 Sep 1968, United States of America (USA).

A method is described for determining the radiation dose effected by a source of radiation, comprising the steps of exposing a detector to a source of radiation, the detector selected from the group consisting essentially of LiF, BeO, $CaSO_4$, $BaSO_4$, $SrSO_4$, $LiB_2B_4O_7$, and CaF_2, heating the detector to a selected temperature to maximize the emission of electrons from the surface, and counting such electrons with a counter whose inner wall is coated with the selected material of the detector to provide an indication of the dose, and utilizing any differences in the response of the detector for determining the linear energy, transfer rate of respective types of radiation that may be present in the source. (auth)

21318 DOSIMETRY BY MEANS OF THE NUCLEAR TRACK METHOD. Faengewisch, G. L.; Scharmann, A. (Univ., Giessen, Ger.). Kerntechnik; 15: No. 5, 207-213(1973). (In German and English).

The nuclear track method is suitable for demonstrating on the surface of insulating detector materials the effects of impact of heavy particles with a sufficiently high linear energy transfer (LET). The zones of detector material damaged by the impinging particles are enlarged by etching after irradiation, and can then be counted, e.g., under a light microscope. Neutrons cause tracks indirectly, by secondary products such as alpha or fission particles. By appropriate choice of various reaction partners for the neutrons it is possible to arrive at a coarse energy discrimination. Neutron dosimetry by this method is not disturbed by the concurrent presence of gamma radiation because the LET values of this radiation are below the detection threshold. The importance of the nuclear track method is stressed by listing further application possibilities. (GE)

21319 DETECTION AND RECORDING OF THERMALLY STIMULATED EXOELECTRONS. Moreno, A. M. (Univ. Nacional de Mexicon, Mexico City). Nucl. Instrum. Methods; 111: No. 1, 21-27(1973).

The behavior of a proportional counter, coupled to a multichannel analyzer, for the study of thermally stimulated exoelectrons (TSEE), is described. The analyzer may be operated in both the multiscalar and the pulse height modes. With this instrumentation the following parameters have been determined: (a) the relative gas gain of the counter for the detector sample holder at the following temperatures: 25, 50, 100, 200°C; (b) the point of onset of spurious pulses; and (c) the dosimetric behavior of pure and activated LiF(Mg)(Ti) and BeO. The advantages of the electronic instrumentation as compared with that used conventionally for the detection of TSEE are discussed. (auth)

21320 NOTES ON NEUTRON DOSIMETRY. David, L. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Acta Cient. Venez., Supl.; 22: No. 3, 161-167(1972). (In Spanish).

The solution of three important problems in neutron dosimetry is presented: (1) results of measurements of the relative thermal flux distribution in the core of the RV-1 reactor, (2) maximum uncertainty interval in the determination of neutron fluence, and (3) fluence-dose conversion factors in a tissue-equivalent material. (auth)

21321 COMPARISON OF SOME TLD DOSIMETRY SYSTEMS. Hasman, A.; Groothedde, R. T. Brit. J. Radiol.; 46: No. 548, 637-640(Aug 1973).

A comparative evaluation has been made of the following TLD dosimetry systems in a hospital primarily interested in the measurement of gonadal doses: (1) the Harshaw model 2000 thermoluminescence analyzer with $CaSo_4$ (Dy) phosphors embedded in Teflon; (2) the National UD-505A dosimetry system (Matsushita Electric) with BeO and $CaSO_4$ (Tm) dosimeters; (3) the Teledyne reader using $CaSo_4$ (Dy); and (4) the Eberline TLR-5 analyzer

used with LiF chips. The comparison of readout as a function of exposure was made over a range of 0 to 10^4 mR and a study made of the response relative to the response at ^{60}Co energy in the energy range from 10 keV to 10 MeV. It is pointed out that the sensitivity of the $CaSO_4$ (Dy) Teflon discs was a factor of 30 greater than the LiF phosphors, but that there was a disadvantage in the energy dependence of the response. For the measurement of exposures less than 5 mR, the $CaSO_4$ (Tm) and $CaSO_4$ (Dy) gave the best results. Rod shaped $CaSO_4$ (Tm) dosimeters with compensation shields gave a good performance over a large energy range. (UK)

21322 ABSOLUTE DETERMINATION OF THE DOSE ADSORBED BY GRAPHITE USING A QUASIADIABATIC CALORIMETER. Hohlfeld, K. (Physikalisch-Technische Bundesanstalt, Brunswick). Rev. Gen. Therm.; 12: No. 137, 461-466(May 1973). (In French).

From 4th meeting on calorimetry and differential thermal analysis; Paris, France (4 May 1972).

The dose absorbed by graphite (the energy is assumed to be completely converted into heat) can be determined using a quasi-adiabatic calorimeter. The calorimeter is described together with its calibration and control circuits. The various corrections to be applied are indicated. (FR)

21323 IMPROVEMENTS TO DEVICES FOR MEASURING THE DOSE RATE FROM AN IONIZING RADIATION BEAM. Boux, R. (to Thomson-CSF). French Patent 2,134,296. 30 Apr 1971. 9p. (In French).

A device is described for the measurement of dose rates resulting from ionizing radiation (β or γ) beams. The device consists of two identical ionization chambers, each of which ensures the measurement of the dose rate from the beam. These ionization chambers are each provided with two insulated collecting semielectrodes positioned between two plates. The chambers are positioned perpendicular to the beam in such a way that the lines separating the semielectrodes are orientated at right angles with respect to one another in order to provide information about the beam position from comparisons between the two signals obtained. (FR)

21324 USE OF RADIORESISTANT SOLID STATE DETECTORS FOR THE MEASUREMENT OF HIGH RADIATION DOSES. Osvay, M. (Isotope Inst., Budapest); Tarczy, K. Izotoptechnika; 16: No. 6, 307-327(Jun 1973). (In Hungarian).

The use of p-n junctions formed in Si crystals, due to their higher radiosensitivity and radioresistance, proved to be more convenient detectors than n-type crystals. (auth)

21325 DOSIMETRY PROGRAM OF THE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT. Reich, H. (Physikalisch-Technische Bundesanstalt, Brunswick). Atomkernenergie; 21: No. 4, 259-261(1973). (In German).

From joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik e.V. and the Deutsche Gesellschaft fuer Medizinische Physik e.V.; Erlangen, Germany (4 Oct 1972).

The extension of dosimetry to higher energies and the proposed legislation for the introduction of obligatory calibration of radiation protection dosimeters in 1976 has made it necessary to enlarge the Photon and Electron Dosimetry Group of the Physikalisch-Technische Bundesanstalt. In addition to the well-established calibration of dosimeters for x- and γ-rays, up to the energy of ^{60}Co, two other services are provided. In co-operation with the National Physical Laboratory, London, a chemical dosimeter calibration service for high energy photon and electron beams is offered twice per year. In the near future it will be possible to calibrate ionization chamber dosimeters in a phantom at high energies using a calorimeter or several standard chambers. (GE)

21326 CRITICALITY NEUTRON DOSIMETER USING THE $^{103}Rh(n,n')^{103m}Rh$ REACTION. Ing, H.; Cross, W. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys.; 25: No. 3, 291-297(Sep 1973).

A fast neutron personal dosimeter using the $^{103}Rh(n,n')^{103m}Rh$ reaction has two important advantages over conventional activation dosimeters. It has a lower energy threshold and yields dose readings which are effectively independent of spectral shapes over the neutron energy range from 0.75 to 10 MeV. This paper describes the characteristics of the dosimeter in detail, shows the counting equipment associated with its usage, and provides the necessary data for count-to-dose conversion. The performance of the dosimeter under laboratory and simulated criticality conditions is also presented. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 22229, 22230, 22933, 22942, and 23976.

21327 (CEA-CONF-2308) SPECTROMETRY OF LOW ENERGY PHOTONS USING SEMICONDUCTOR DETECTORS. Friant, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 26 Apr 1973. 20p. (In French). (CONF-730557-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting for studies of gamma spectrometry; Grenoble, France (7 May 1973).

The usefulness of Si(Li) detectors in low-energy (from the 280 eV C line up to 100 keV) x-ray spectrometry is examined. The analytical characteristics of these detectors are analyzed (resolution, permissible count rate, efficiency, and detection threshold). Si(Li) detectors are stable at room temperature and thus offer a large degree of operational safety in the event of an accidental overheating. Nevertheless, in order that the room temperature resolution is sufficiently high to detect low energy photons, it is necessary that a diode proportional counter operating in a controlled avalanche region is used. Detectors made at room temperature using semiconductors having a forbidden band larger than that of Si including GaAs, CdTe and HgI_2 are briefly discussed. (FR)

21328 (CEA-CONF-2315) ADVANTAGES OF INTEGRATING A SMALL COMPUTER INTO A DATA ACQUISITION AND PROCESSING UNIT HANDLING A LARGE NUMBER OF GAMMA SPECTRA. Hulot, J. P.; Monier, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 26p. (In French). (CONF-730557-2). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting for studies of gamma spectrometry; Grenoble, France (7 May 1973).

A system is presented which utilizes a minicomputer as a basic unit. The system is used to function the electrochemical servo-control positioning of samples, to operate simultaneous multi-channel data acquisition, to store a large number of spectra (2, 4, to 6000 spectra on 2048 channels), to provide a visual display of some spectra, to calculate the area beneath the peaks, and to arrange the results in a convenient form for publication or presentation in a report. (FR)

21329 (GULF-RT-10487) PROTON RECOIL DATA ANALYSIS AT GULF RADIATION TECHNOLOGY. Borgonovi, G. M.; Bromley, G. E. (Gulf Radiation Technology, San Diego, Calif.). 26 Jan 1971. Contract AT(04-3)-167. 26p. Dep. NTIS $3.50.

Some of the computer codes for reduction of proton recoil ionization data for the measurement of neutron spectra between a few keV and 2 MeV using proton recoil proportional chambers are described. Codes DVDT, JOIN, IDEAL, and SNWR are described. (WHK)

21330 (LYCEN-7283) MATRIX STUDY OF THE CHARACTERISTIC PROPERTIES OF A MAGNETIC SYSTEM AND THE DEVELOPMENT OF A DETECTOR SYSTEM FOR SMALL ANGLES. Application to the $^{20}Ne(d,p)^{21}Ne$ Reaction. Elayi, A. G. (Lyon Univ. (France)). Oct 1972. 88p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis.

A new working instrument provided with a double focusing magnetic system was developed. It enables the products induced by 4 MeV deuteron reactions to be detected at small angles. Instead of studying the double focusing produced by the magnets (1st order) and then the aberrations (2nd order), various aspects of the double focusing (image size in the horizontal and vertical planes at a given distance etc.) were considered, and a matrix equation established for the object/image transformation produced by the electromagnet. The physical meaning of the equations thus obtained was interpreted and several programs written for their numerical solutions. Theoretical investigations demonstrated that it is impossible to obtain a double focusing for the 3.5 MeV deuterons in the contact of the (d,p) reactions studied. The double focusing of the deuterons was sacrificed for a more simple apparatus (30 deg for 4.5 MeV protons). The apparatus finally developed consists of a circular magnet having characteristics very similar to those of the 30 deg magnet and a performance appropriate for the task envisaged. The $^{20}Ne(d,p)^{21}Ne$ reaction was used to test the experimental equipment. The results obtained enabled the characteristics of the 5777 keV level to be determined for the first time and the experimental ambiguity existing for the 5777 to 5822 keV doublet to be removed. In addition, the results led to the determination of the characteristics of the 5694 keV level. The corresponding cross sections were measured at 6 deg 30' in the laboratory system. An E−ΔE system would enable measurements to be made at very much smaller angles. (FR)

21331 (N-73-17580) TEST REPORT: ELECTRON−PROTON SPECTROMETER QUALIFICATION TEST UNIT, QUALIFICATION TEST. Vincent, D. L. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). Mar 1972. Con-

tract NAS9-11373. 619p. (NASA-CR-128703; LEC/EPS-695). NTIS.

Qualification tests of the electron–proton spectrometer test unit are presented. Functional, thermal/vacuum, electromagnetic interference, acoustic, shock, vibration, and humidity tests were conducted. Results of each type of test are presented in the form of data sheets. (auth)

21332 (RD/B/N-2538) OPERATING MANUAL FOR THE GAMMA SCANNING MACHINE AT THE A. G. R., POST-IRRADIATION EXAMINATION PLANT, A. E. E. WINFRITH. Raine, S. M.; Polley, M. V. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1973. 124p. Dep. NTIS (U. S. Sales Only) $8.25.

A detailed description of the gamma scanning equipment is presented. Scanning, using Ge(Li) gamma ray detectors, may take place in either of two rigs, in order to determine fission product activities as a function of axial position. One rig provides data for reactor physics work and the other for materials studies. Reactor physics data in the form of condensed spectra is punched out on paper tape and, for the materials work, gamma photopeak areas are printed out on a teletype. Chart recorders provide a visual display of axial gamma activity. Measurements in both rigs can be made simultaneously and automatically under the control of a PDP 11 computer, and interfacing to the computer is effected by means of a single crate CAMAC system. A control desk both monitors the state of the system and provides additional control. The nature of the measurements is described and detailed instructions for the operation and maintenance of the equipment are given. (auth)

21333 SELF-CONSISTENT TRANSFORMATION OF BREMSSTRAHLUNG TO MONOCHROMATIC PHOTONEUTRON MEAN ENERGIES OF NON-MAXWELLIAN NEUTRON SPECTRA. Koch, R.; Crawford, D. M.; Boettcher, K.; Thies, H. H. (Univ. of Western Australia, Nedlands). Aust. J. Phys.; 26: No. 2, 117-121(Apr 1973).

The mean energy of neutrons produced in a bremsstrahlung experiment can be measured using "energy sweeping" and a multi-BF_3-counter neutron detection system. It is shown how one can obtain from a relatively simple type of experiment the required calibration data of the detection system to permit a self-consistent transformation of the bremsstrahlung data to the equivalent monochromatic photon data for neutron spectra that are non-Maxwellian. (auth)

21334 DERIVATION AND EXPERIMENTAL VERIFICATION OF THE NORMALIZED RESOLUTION FUNCTION FOR INELASTIC NEUTRON SCATTERING. Chesser, N. J.; Axe, J. D. (Brookhaven National Lab., Upton, NY). Acta Crystallogr., Sect. A; 29: No. 2, 160-169(1 Mar 1973).

Based upon the work of Cooper & Nathans, an expression for the normalized resolution function of a triple-axis neutron spectrometer is derived and tested experimentally. The formalism is extended to show the explicit dependence of the integrated intensity of a sharp excitation spectrum on all of the relevant instrumental parameters. Extensive measurements of the integrated intensities of phonons in copper have been carried out for a wide range of all adjustable parameters. The experimentally determined intensities are found to be in good agreement with the calculated values. (auth)

21335 ELECTRODE DEVICE FOR CONTROLLING THE DEGREE OF VACUUM IN AN ENCLOSURE. Fremion, L. (to Commissariat a l'Energie Atomique). French Patent 2,135,745. 27 Apr 1971. 8p. (In French).

A device using electrodes to control the degree of primary or secondary vacuum in an enclosure (particularly the enclosure of a β spectrometer) is presented. Two electrodes, connected to a power supply circuit, are positioned in a sealed enclosure, which is joined to the reservoir whose pressure is to be controlled, the enclosure being enclosed in grounded shielding. The ends of the electrodes are separated by a space such that at the normal pressure of the reservoir, ionization does not occur. (FR)

21336 PROPORTIONAL COUNTER FOR MOESSBAUER SPECTROSCOPY BY SCATTERED ELECTRONS. Takafuchi, M.; Isozumi, Y.; Katano, R. (Kyoto Univ., Uji, Japan). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 13-18(Jan 1973).

A proportional counter with a very small sensitive volume (250 $mm^2 \times 3$ mm) has been constructed for Moessbauer spectroscopy by scattered electrons. More than 20% effect with a 100% baseline has been obtained for an unenriched sample of Type 310 stainless steel with a helium-10% methane mixture flowing through the counter. Some features of the counter are described. (auth)

21337 APPLICATION OF THE HELICAL CATHODE PROPORTIONAL CHAMBER TO MAGNETIC SPECTROGRAPHS FOR NUCLEAR REACTION STUDIES. Flynn, E. R. (Los Alamos Scientific Lab., NM); Orbesen, S.; Stein, N.; Thiessen, H. A.; Lee, D. M.; Sobottka, S. E. Nucl. Instrum. Methods; 111: No. 1, 67-76 (1973).

A proportional chamber with a single wire helical cathode has been employed in the focal plane of a magnetic spectrograph for nuclear reaction studies. The spatial resolution attributable to the detector is less than 0.33 mm fwhm over its 25 cm length with particles incident at an angle of 37° to the plane of the detector. The resolution achieved with a collimated ^{55}Fe x-ray source at normal incidence was 0.25 mm. Rates of 10^5 counts/s are possible before degradation of the peak shapes is observed. The dE/dx resolution is 27% for protons, deuterons and tritons in the energy range of 10 to 16 MeV. The counter has been used with an on-line computer program to measure the $^{27}Al(d,p)^{28}Al$ and $^{59}Co(t,d)^{60}Co$ differential cross sections. (auth)

21338 ABSOLUTE VELOCITY-SENSE DETERMINATION IN MÖSSBAUER SPECTROMETRY. Yeboah-Amankwah, D. (Department of Physics, University of Ghana, Legon, Ghana). Rev. Sci. Instrum. 44: No. 2, 222-224 (Feb 1973).

A method for determining absolutely the velocity sense of a Mössbauer spectrum taken in the multiscaler mode is described. It is shown that relative motion of the Mössbauer source with respect to the absorber naturally leads to a parabolic profile of the absorption spectrum. This parabola is used to determine the sense of the different sections of the spectrum uniquely without reference to a standard asymmetric Mössbauer spectrum. (auth)

21339 COMPTON SCATTER ATTENUATION GAMMA RAY SPECTROMETER. Fletcher, J. C.; Austin, W. E. U. S. Patent 3,752,986. 14 Aug 1973. Filed Date 3 Mar 1972. 14p.

A gamma ray spectrometer system for obtaining gamma ray spectra from intense gamma field containing significant neutron is described. Spectra are measured for a continuous gamma spectrum from about 50 keV to 7 MeV or higher. A radiation shield protects individual spectrometers from the incident radiation. An aperture in the shield admits a collimated radiation beam. Compton scattering targets are placed in the radiation beam to scatter part of the beam into the individual spectrometers. The targets are made changeable to control the rate at which radiation strikes the spectrometers. Two spectrometers are used, one for low energy radiation and one for high energy radiation. The axis of the low energy spectrometer is placed at a 60° angle to the radiation beam and the high energy spectrometer is placed at a 20° angle to the radiation beam. The spectrometers are rotationally symmetric and comprise an inner or "A" detector on which the radiation is incident and an outer or "B" detector which is subject to radiation scattered in detector A. The spectrometers employ sum-compton coincidence techniques to distinguish signal events from background events. The output from the A & B detectors of one spectrometer is amplified and added together to represent the entire energy released by an event. The individual amplified signals are also converted to bipolar waveforms. The time of the zero crossing of each bipolar waveforms is compared to determine whether the two events occurred simultaneously and are a signal event. If the events are simultaneous and the quantity of energy deposited in the B detector is of an appropriate amount, the energy representing signal is gated to a multichannel pulse height analyzer to determine the energy of the incident radiation which created the event. This information is recorded for readout and analysis. When the number of coincident events counted by a spectrometer exceeds 10^4 per second, the Compton scattering targets are changed to less dense ones which scatter a smaller percentage of the radiation beam and thus reduce the count rate. (Official Gazette)

21340 APPARATUS FOR SEPARATING CHARGED PARTICLES ACCORDING TO THEIR RESPECTIVE RANGES. Koike, H. (to Nihon Denshi Kabushiki Kaisha). U. S. Patent 3,745,337. 10 Jul 1973. Filed Date 12 May 1971. 6p.

An apparatus for separating charged particles according to their respective energies is described. The charged particles are decelerated and passed through a long cylindrical electrode having a focusing coil. Since the velocity of the particles differs according to their respective energies, the particles are separated in the electrode and exit the electrode at different times. (Official Gazette)

High Energy Physics Instrumentation

Refer also to abstracts 22205, 22775, and 23273.

21341 (BNL-18038) RECENT PROGRESS IN TRANSITION RADIATION DETECTOR TECHNIQUES. Yuan, L. C. L. (Brook-

haven National Lab., Upton, N. Y.). 1973. 15p. (CONF-730531-7). Dep. NTIS $3.00.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

A brief review of the principal characteristics of transition radiation is given and a list of some of the major experimental achievements involving charged particles in the relativistic region are presented. With the emphasis mainly directed to the x-ray region of the transition radiation, certain modes of application of the transition radiation for the identification and separation of relativistic charged particles are discussed. Some recent developments in detection techniques and improvements in detector performances are presented. Experiments have also been carried out to detect the "dynamic radiation," but no evidence of such an effect was observed within the sensitivity of the present experiments. (28 references) (auth)

21342 (CEA-N-1600, pp 121-125) DEVELOPMENT OF THE 1-GeV SPES I SPECTROMETER. Bertini, R.; Beurtey, R.; Birien, P.; Brochard, F.; Bruge, G.; Catz, H.; Chaminade, R.; Chaumeaux, A.; D'Agostino, A.; Duchazeaubeneix, J. C.; Durand, J. M.; Faivre, J. C.; Fontaine, J. M.; Garreta, D.; Hendrie, D.; Hibou, F.; Laspalles, C.; Legrand, D.; Lugol, J. C.; Poussard, H.; Re, C.; Saudinos, J.; Thirion, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The main features of the SPES I facility, devoted to nuclear physics studies in the 1-GeV proton range, are described. Results show an energy resolution of 130 keV for the scattering of 1.04-GeV protons by ^{58}Ni and the ability to determine angular distributions with an angular resolution equal to 6 mrd or better. (auth)

21343 (CEA-N-1600, pp 128-130) OPTIMIZATION OF THE OPTICS OF THE 1 GEV SPECTROMETRY SYSTEM. Garretta, D.; Legrand, D. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

A method was developed that allows automatic adjustments to be made to the different parameters of the Saturne 1-GeV spectrometer system (currents in the magnetic elements and target angle), using the measured field maps. (auth)

21344 (CEA-N-1600, pp 187-189) ELECTRONICS ASSOCIATED WITH THE DETECTORS IN THE HE1 ROOM. Auriol, E.; Lefevre, M.; Lemarchand, G.; Millaud, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The data acquisition system for the HE1 1600-channel multiwire proportional counter was improved in order to obtain a better data resolution at a higher count rate. A special testing generator was developed for use with the computer: in this way a faster operational set-up and maintenance can be achieved. A preliminary 64-channel detector was constructed for simulation. (auth)

21345 (CERN-73-7) STUDY OF A DETECTOR FOR HIGH-ENERGY PARTICLES: THREE-DIMENSIONAL PROJECTION CHAMBER. Breskin, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Jun 1973. 140p. (In French). Dep. NTIS (U. S. Sales Only) $9.00.

The design and operation of a multi-interval projection chamber are discussed. The photographic system, operating parameters, high-voltage pulse system, and geometrical parameters are elaborated. (WHK)

21346 (LA-5310-MS) EPICS BIFILAR HELICAL CHAMBER INTERFACE ELECTRONICS AND DATA ACQUISITION SYSTEM. Nickell, J. D. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 35p. Dep. NTIS $4.00.

A recently developed electronics system that will be used to read out data retrieved from a multiwire bifilar helical chamber is described. Information processed by the chamber interface electronics will be transmitted to a CAMAC data module where it will be retained until an FNA command demanding readout is received. A CAMAC test module is also included in the system to facilitate dynamic testing of the amplifiers, discriminators, and the chamber interface electronics coding. Each of the three units comprising the system is described separately. (auth)

21347 (LBL-2053) MULTIWIRE PROPORTIONAL CHAMBER (MWPC) COINCIDENCE MATRIX. Harms, M. G. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-Eng-48. 53p. Dep. NTIS $4.75.

Thesis.

A brief explanation of the physics of multiwire proportional chambers and their uses in high-energy physics experiments is given. This particular project attempts to resolve "coincidently" pulsed wires on different chambers for five physically different experimental configurations. It employs three general types of circuits, each functionally distinct. Driver units provide line termination, signal regeneration, and fixed time delay insertion. Matrix boards govern the "valid coincidence pairs" as determined by the physical arrangement of two sets of MWPCs and the experimenter's target. Receiver boards counteract crosstalk while providing a "coincidence" output only when the predetermined pairs of wires from separate MWPCs are activated. A prototype model is discussed, and results from the completed boards are explained in their relationship to the project requirements. (auth)

21348 (RHEL/R-271) PROCEEDINGS OF A SEMINAR ON TRACK ANALYSIS FOR RAPID CYCLING BUBBLE CHAMBERS, CHILTON, FEBRUARY 14, 1973. Lawes, R. A.; Fisher, C. M. (eds.). (Rutherford High Energy Lab., Chilton (England)). Mar 1973. 200p. (CONF-730215-). Dep. NTIS (U.S. Sales Only) $12.25. UK 2.50 pound.

Separate abstracts were prepared for the 11 papers presented. (WHK)

For abstracts of individual papers see: 21349–21359.

21349 (RHEL/R-271, pp 1-20) PHYSICS AND ON-LINE DATA REDUCTION WITH RAPID CYCLING BUBBLE CHAMBERS. Fisher, C. M. (Rutherford High Energy Lab., Chilton, Eng.). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The possible advantages of the vidicon (on-line readout system) and the philosophy of operation are outlined. The system might be used either as part of the trigger or on on-line measuring. Two distinct roles for the rapid cycling bubble chamber, as a vertex detector and as a triggered bubble chamber are identified and discussed in the light of the value of measuring techniques. A detailed comparison of vidicons and films is made from which it is found that the vidicon should not be regarded as a realistic alternative to film for low cross-section processes but that it is possibly an essential replacement for high cross-section studies. Examples of possible future applications requiring on-line data reduction are discussed. Finally the following questions are posed; what resolution and precision is achievable with a vidicon, the dead time of the vidicon system, can a useful internal trigger be devised to operate within the 1 to 2 msec bubble growth time, and what can be done between machine cycles assuming vidicons are exposed? (UK)

21350 (RHEL/R-271, pp 21-31) RAPID CYCLING VERTEX DETECTOR. Newport, R. (Rutherford High Energy Lab., Chilton, Eng.). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The Rutherford High Energy Laboratory rapid cycling bubble chamber as originally conceived was not intended to be used as an instrument on its own and indeed it was intended for use with other particle detectors in a hybrid system and hence the name vertex detector. Due to experiments proposed for the detector it has been increased in size and so can be used as a bubble chamber with contour triggered cameras. The use with other detectors even if these are only to be used to trigger the cameras of the vertex detector impose certain requirements on the design, i.e., it should be capable of being viewed over as large a solid angle as is possible by external particle detectors, it should be constructed so that its walls are as transparent as possible to nuclear particles and radiation, it should be capable of operating at high frequency so as not to limit the data collecting rate, and the data collection should be compatible with that for the other detectors in the system. The specification for the chamber, operating frequency, fluids, expansion system, optical system and resolution, stereo angle, cameras and refrigeration system are described. The future possible use of vidicons in place of film cameras so that data can be digitized and recorded on-line in the same form as that from the other particle detectors is discussed. (UK)

21351 (RHEL/R-271, pp 33-46) VIDICON READ-OUT FOR SMALL CHAMBERS. Amato, G.; Powell, B. (CERN, Geneva). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The two basic types of camera tube construction, the direct readout tubes or vidicons and the return-beam readout types are described. Vidicons have a major advantage from the user's point of view, being simpler to set up and significantly more compact. The return-beam types have appreciably greater sensitivity and the tubes which offer the greatest resolution to date operate in this mode. The main characteristics of camera tubes including sensitivity, lag, resolution, and dark current are reviewed. It is pointed out that problems which are minor for normal television

are more serious in this special application and as examples bandwidth, beam pulling and beam landing errors, brightfield illumination and stability are considered. A possible match between the vidicon and the chamber is considered and future work outlined. (UK)

21352 (RHEL/R-271, pp 47-67) EXPERIENCE WITH RAPID CYCLING HYBUC. Manz, A.; Reucroft, S.; Settles, R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

Hybuc, a hydrogen bubble chamber of 30 cm length and 12 cm diameter with an 11 Tesla field produced by a superconducting magnet was tested in the rapid cycling mode to study the feasibility of using it for measuring processes with cross sections in the 10 to 100 μb range. Details of the test and results are given. On the basis of the experience gained it is considered that, to hold a constant expanded pressure during rapid cycling at 50 Hz, it will be necessary to operate at $\lesssim$8.5 msec stroke width, introduce a variable function generator to change the stroke amplitude as a function of stroke number, and/or feed back the dynamic pressure into the expansion servo-system, increase the static pressure on the chamber to give more over-pressure for recompressing parasitic bubbles, and improve the geometry of HYBUC by replacing the chamber body. (UK)

21353 (RHEL/R-271, pp 69-108) EXPERIENCE WITH THE OMEGA CAMERA SYSTEM. Garvey, J. (Univ. of Birmingham, Eng.). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The characteristics of the Omega spectrometer and in particular the characteristics of the set of television cameras used to digitize the positions of the sparks in the spark chambers are presented. Investigations of the stability, distortions produced, accuracy, sensitivity, two spark resolution, and off-line analysis of the camera system are discussed. It was found that helix fit residuals of the order of 500 μm were attainable over 3 metres which would correspond approximately to 50 μm in the 30 cm rapid cycling chamber which shows that the vidicon does not compromise on precision. (UK)

21354 (RHEL/R-271, pp 109-118) SOFTWARE CONSIDERATIONS FOR THE RAPID CYCLING CHAMBER. Hall, D. E. (Rutherford High Energy Lab., Chilton, Eng.). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The problem of creating software for the rapid cycling chamber with a vidicon trigger is reviewed in light of experience with the zero guidance system DAPR. The problem is broken down into several sub-problems, and estimates of the efficiency data reduction factor, core requirements, and timing on the CHORD computer are given. It is considered that all subproblems, except for final event recognition, should be carried out online, but a simplified event recognition algorithm must be developed to provide statistics to the quality monitoring program. (UK)

21355 (RHEL/R-271, pp 119-132) BRUSH PICTURE PROCESSING WITH RAPID CYCLING SYSTEMS. Ruediger, A.; Schilling, R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The feasibility of using BRUSH on line with a rapid cycling bubble chamber for detecting tracks and reducing the data has been studied. This assessment is based on a hypothetical HYBUC experiment, but the results can be generalized to other rapid cycling chambers or to streamer chambers. The study showed that two low-cost BRUSH computers, modelled after the existing one, can deal with the expected data rate, assuming a very conservative trigger ratio by external detectors. A further crude selection could be made after a 2D reconstruction of tracks in the central veiw only, requiring a relatively fast computer with moderate storage capacity. This could be an effective way to reduce the number of pictures handed to an off-line 3D geometry program. (auth)

21356 (RHEL/R-271, pp 133-153) PATTERN RECOGNITION PROCESSOR. Soloman, J. (Rutherford High Energy Lab., Chilton, Eng.). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The properties of the Pattern Recognition Processor in its application to spark chamber data analysis are discussed. Its adaption for use in analyzing HPD bubble chamber data and for use in a vidicon trigger for the rapid cycling bubble chamber is considered. The hardware serves as a peripheral device to a digital computer, receiving both data and operating instructions from it and returning search results back to it. Because the hardware performs a logic algorithm and does many operations in parallel, it is able to locate line segments within a large data field quite rapidly. It is this arrangement of computer controller hardware which gives the device both flexibility and speed. (auth)

21357 (RHEL/R-271, pp 155-173) POINT AND TRACK FINDING PROCESSORS FOR MULTIWIRE CHAMBERS. Hansroul, M.; Verkerk, C. (CERN, Geneva). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

Three hardware processors to be used in conjunction with multiwire chambers are described. These processors are expected to execute 2 to 3 orders of magnitude faster than the equivalent Fortran programs on a CDC 7600 or 6600. It is shown that it is perfectly feasible and very fast by hardware implementation to find particle tracks even when the number of tracks and the number of points per track exceeds 3 or 4. (UK)

21358 (RHEL/R-271, pp 175-184) POLYNOMIAL EVALUATOR. McPherson, G.; Wilde, P. (Rutherford High Energy Lab., Chilton, Eng.). Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

Data obtained from measuring instruments, such as vidicons used to obtain positional information from spark or bubble chambers, are prone to systematic errors. These errors can be removed by using measurements from a fiducial system to obtain a correcting polynomial giving true position as a function of measured position. To overcome the time consuming evaluation of this function a special-purpose digital machine capable of evaluating polynomial functions at high speed can be used. When placed between the digitized detector output and the computer input it provides a "perfect" detector, or alternatively it can be viewed as a special-purpose computer peripheral performing fast subroutine. The system is described. Future developments will include a hardware floating point capability, more flexible command and microprogramming to allow calculations to be "chained" in the machine rather than referring (with a time penalty) back to the host computer, and the use of Read Only memories for widely used general purpose functions. (UK)

21359 (RHEL/R-271, pp 185-199) VIDICON TRIGGER AND DATA PROCESSING SYSTEM FOR A RAPID CYCLING BUBBLE CHAMBER. Fisher, C. M. (Rutherford High Energy Lab., Chilton, Eng.); Lawes, R. A.; Powell, B. Mar 1973.

From seminar on track analysis for rapid cycling bubble chambers; Chilton, England (14 Feb 1973).

The proposed Rapid Cycling Bubble Chamber, if operated to its full data collection potential, would saturate existing film analysis facilities. A VIDICON camera system is examined to either provide a topology trigger for film cameras or to completely replace film cameras in a track measurement mode. VIDICON cameras coupled to the general purpose on-line data reduction device CHORD would allow direct read-out of track variables onto magnetic tape. The bubble chamber data could be merged with data coming from external counter systems in a digital form. (auth)

21360 75 cm HYDROGEN BUBBLE CHAMBER. Hirabayashi, H.; Tateno, H.; Yoshimura, Y. (Tokyo Univ.). Jap. J. Appl. Phys.; 11: No. 8, 1187-1191 (Aug 1972).

A 75 cm hydrogen bubble chamber with 220 liters of liquid and its refrigerator were constructed. In the latest run the chamber was successfully operated and the tracks of cosmic rays and Compton electrons from cobalt-60 gamma rays were seen and photographed. This chamber has several grand features for the improved characteristics of operation and the precision photographs of tracks. Some of those essential features and the results of the operations are reported. (auth)

21361 RECENT ADVANCES IN BUBBLE CHAMBER PHYSICS. Kalmus, G. E. (Univ. of California, Berkeley). Rep. Progr. Phys.; 36: No. 8, 961-1072 (1973).

The growth of high-energy physics after the advent of particle accelerators in the GeV energy range is closely linked with the bubble chamber technique. By means of a series of examples in strong and weak interaction physics both the early and more recent work is examined. The importance of the technique in the past and its future applications are discussed. Four appendixes give thumbnail descriptions of some of the definitions and theory used in the article. (auth)

21362 SPARK CHAMBERS IN HIGH-ENERGY PHYSICS. IV. Supply Systems of the Spark Chambers. Glowacki, J.; Olejniczak, W. (Univ. Lodz, Poland). Postepy Fiz.; 24: No. 2, 243-254 (1973). (In Polish).

Permissible parameters of the high-voltage pulses affecting the accuracy of different types of the spark chambers are discussed. Examples of the technological solutions of the particular elements of the supply-generator and their influence on the work of the spark chamber are presented including the circuit diagrams of the supply-generator and the spark chamber. Methods of control of the spark chamber supply are discussed. The cascade generators of the high-voltage pulses used in the spark chamber technique are discussed. (auth)

21363 FRENCH–US COSMIC RAY EXPERIMENT IN THE MONT BLANC TUNNEL. Sheldon, W. R. (Univ. of Houston, TX); Bazer-Bachi, A. R.; Vedrenne, G.; Dunet, C.; Monchant, M.; St. Marc, A.; Cantrell, W. G.; Duller, N. M. Nucl. Instrum. Methods; 111: No. 1, 133-155(1973).

The cosmic ray muon hodoscope-telescope which has been operated in the Mont Blanc tunnel is described. The instrument has been used to measure the directional underground muon intensity at depths of 700 to 4500 hg/cm^2 and at zenith angles from the vertical to 80°, utilizing the favorable geometry provided by the location within the Mont Blanc. The hodoscope provides a resolution of about 1° within a half angle which varies from 24° to 32° (diagonal) and has a geometrical factor of 4448 cm^2 sr. A detailed account is given of the electronic circuitry used to record muon trajectories and to check the performance of the 576 Geiger counters which comprise the hodoscope. The data handling procedures are provided, along with the Monte Carlo techniques used to investigate the detector. Evidence for proper and consistent operation of the instrument is shown. The image of a neighboring mountain apparent in the muon flux is adduced as convincing evidence that the instrument is detecting only energetic muons and that these muons have not been significantly scattered in direction in their passage through substantial thicknesses of rock. It is concluded that data from the present instrument can be used to determine the directional underground muon intensity with great accuracy. (auth)

21364 DRIFT COUNTER FOR LOCALIZATION OF PARTICLES. Saudinos, J.; Duchazeaubeneix, J. C.; Laspalles, C.; Chaminade, R. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 111: No. 1, 77-81(1973). (In French).

A drift counter used to localize particles in the 1 GeV proton experiment at Saclay is described. A spatial resolution going from 0.6 mm for 10 cm drift to 1 mm for 30 cm drift and 1.6 mm for 50 cm drift is obtained. The 7 μs memory time of the drift detectors is not a limitation because they are used in multiple coincidences. (auth)

21365 MODERN EXPERIMENTAL TECHNIQUES. Sonderegger, P. (CERN, Geneva). pp 471-530 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

Lectures are presented on the techniques of experimental particle physics. In the first part the basic tools are reviewed: accelerators, beams, targets, and detectors. The second part deals with various kinds of spectrometers and their impact on some classical fields of phenomenology such as particle radii and $\pi-\pi$ scattering. The main emphasis is on electronic techniques. (LBS)

Radiometric Instruments

Refer also to abstracts 21143, 21465, and 21468.

21366 (CONF-721091-, pp P4.p1-P4.p6) USING RADIOISOTOPE INSTRUMENTS: SOME LESS TECHNICAL ASPECTS. Farquharson, D. C. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Radioisotope instruments considered are measuring instruments which work in conjunction with a radioactive source to provide the measurement required. These include level gages, nuclear belt weighers, thickness gauges, some analytical instruments, etc. In general the sources are relatively safe. The potential user may need some powerful persuasion to move into the use of such instruments because of the statutory regulations governing radioactive nuclides. The investment in time, training, equipment and administration may be large. However, the Atomic Energy Board does its best to minimize the irksomeness of the regulations. Some proposals are made for improving even further the climate for users of these instruments. (auth)

21367 (CONF-721091-, pp P18.p1-P18.p6) REEF/WASTE DETECTOR FOR A GOLD MINE. Morgan, P. R.; Reynolds, C.; Snyman, G. C. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

In mining operations, an experienced miner in the stope makes the decision as to what may be designated gold-bearing reef or waste rock. Occasionally, on its journey to the surface the material is the subject of expensive routing mistakes. An electronic reef/waste detector, which utilizes the gamma-radiation count of material on a conveyor belt, is described. This provides a continuous check on the belt's contents and destination. Suitable alarm functions are provided with an option for connection to a computer for on-line control. (auth)

21368 (NIAZR-118) LABORATORY MEASUREMENT OF SAND DENSITY GRADIENT BY GAMMA RADIATION. Livnat, R. (Negev Inst. for Arid Zone Research, Beersheba (Israel)). May 1971. 20p. (In Hebrew). INIS.

A laboratory method for measuring density variations of up to 1% by gamma-ray transmission is presented. The material tested was sand but the method applies also to other materials such as soils and concrete. (INIS)

21369 A MOVING SOURCE NEUTRON MOISTURE GAUGE. Christensen, E. R. (Danmarks Teknische Hoejskole, Lyngby). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 479-481(Aug 1973).

The theory of a possible moving source neutron gage was investigated using a series of three-group diffusion theory calculations. It is considered that the method is more attractive than the alternative combined thermal-epithermal neutron gage since only one detector is needed and the moisture and absorber concentration determinations refer to the same measuring volume. Whether this is also true for an actual gage depends on the possibilities of fulfilling the principle of similitude and on the necessary counting times to achieve a desired precision. (UK)

21370 COINCIDENCE AND INTERFERENCE CORRECTIONS FOR DUAL ENERGY GAMMA RAY MEASUREMENTS OF SOIL DENSITY AND WATER CONTENT. Mansell, R. S.; Hammond, L. C.; McCurdy, R. M. Soil Sci. Soc. Amer., Proc.; 37: No. 4, 500-504(1973).

Coincidence and interference errors in the dual-energy gamma ray attenuation method are discussed for simultaneous determination of water content and bulk density of soil columns. Collimated radiation from 300 mCi each of ^{241}Am and ^{137}Cs provides a high-intensity beam comprised of 60 and 662 keV photons. Count rates measured by a single detector and a two-channel gamma spectrometer were corrected for coincidence losses due to pulse-resolving time. The lower energy channel counts were also corrected for Compton scattering of Cs radiation and for a counting loss attributable to a special coincidence interference. Mass attenuation coefficients were determined for glass beads, water, and eight soil materials. Errors in soil water content measurement by the dual-energy gamma attenuation method appears to be restricted to standard deviations of approximately 1% due to practical limitations in measurement precision of 60 and 662 keV attenuation coefficients for soil and water. (auth)

21371 UNSATURATED IONIZATION CHAMBER USING THE PRINCIPLE OF SMALL ION ACCUMULATION FOR THE QUANTITATIVE MEASUREMENT OF PARTICLE COLLECTIVES. Hosemann, J. P. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From working meeting on aerosol techniques; Frankfurt am Main, Germany (18 Oct 1972).

For a cylindrical arrangement of electrodes with homogeneous ionization between the electrodes (taking into account the volume recombination), a general equation for the electric field of the measuring chamber can be given. This results in a special solution for the field equation for freedom of space charge. By 5 coupled differential equations describing the recombination and addition of particles (large and small ions) the observed decrease of the ionic current through the chamber can be calculated for aerosol particles penetrating into the chamber. (GE)

21372 RECENT IMPROVEMENTS IN DEVELOPMENT AND FUTURE PROSPECTS OF THE NEUTRON METHOD OF MEASURING SOIL MOISTURE. Couchat, P. (CEN de Cadarache, Saint Paul-lez-Durance, France). pp 41-49 of Soil-Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agench (1973). (In French).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Although the principles involved in the neutron method of soil-moisture determination are well known and the method is widely used in practice, further improvements have been made recently, including: (a) extension of the method's appliability to stony soils; (b) simultaneous counting of thermal and epithermal neutron fluxes, enabling soil moisture to be determined regardless of dry bulk density; and (c) development of a system for measuring Σ_a in a

soil sample, this parameter representing the macroscopic cross-section for the absorption of thermal neutrons in cases of average dry bulk density (the system involves observing the perturbation of the thermal neutron spectrum of water or graphite caused by a dry soil sample and relating the perturbation to the measured Σ_a values). Moreover, preliminary results suggest that it might be possible to build equipment which makes use of the transmission of fast neutrons (about 1 MeV) in determining the moisture content of thin soil layers. Such a method would possess high sensitivity and satisfactory resolution. The field remains wide open for research aimed at developing equipment based on the principles discussed. (auth)

21373 EXPERIENCE WITH AND SOME FEATURES OF THE USE OF GAMMA RAYS AND NEUTRONS IN INVESTIGATING SOIL MOISTURE CONTENT. Danilin, A. I. (All-Union Inst. of Hydrology and Engineering Geology, Moscow). II. Vienna; International Atomic Energy Agency (1973). (In Russian).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Gamma ray and neutron scattering methods of measuring soil mositure are reviewed and their application in the field discussed. The scattering of gamma rays between a detector at the soil surface and a cobalt-60 source located in an access tube at various depths is described, it being regarded as the best method for following changes in the water concentration in surface horizons. For greater depths, down to the groundwater level, neutron moisture meters are recommended; the neutron method has been successfully employed in land improvement and irrigation studies in the USSR and has proved to be more economical than conventional methods. (auth)

21374 MOISTURE MEASUREMENT IN THIN SOIL LAYERS BY ABSORPTION OF GAMMA RAYS IN A CAPILLARY POROUS BODY. Kuehn, W.; Schaetzler, H. P. (Technische Hochschule, Hanover). pp 67-76 of Soil-Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agency (1973).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Water content in thin soil layers is measured indirectly by measuring water content of a capillary porous body in contact with the soil using gamma-ray attenuation. Water content is inferred by taking the slope of a curve giving measured pulse rate of gamma rays passing through the porous body as a function of time. Equipment is described. (auth)

21375 COLLIMATION OF A 60-keV COLUMN SCANNER. Stroosnijder, L. (State Agricultural Univ., Wageningen, Netherlands). pp 77-84 of Soil-Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agency (1973).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Collimation of 60 keV americium-241 gamma rays, as used in a soil column scanner for water content, is described. Lead collimators 9 mm thick, on both source- and detector-side were the final choice determined from experience. (auth)

21376 QUESTIONNAIRE ON THE APPLICATION OF RADIATION EQUIPMENT IN AGRICULTURE. pp 171-177 of Soil Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agency (1973).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Completed questionnaires relative to the use and effectiveness of a neutron moisture meter in various situations were received from 24 respondents in various parts of the world. These replies are summarized. Although certain specific limitations were recognized the neutron moisture meter appears to be used extensively and successfully for a wide variety of measurements under different agricultural conditions. (auth)

21377 NUCLEAR GAUGES IN SEDIMENTOLOGY. Anguenot, F.; Caillot, A. (CEN de Saclay, Gif-sur-Yvette, France). pp 203-216 of Tracer Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The operating principles of various gages used in sedimentology are reviewed. (TFD)

21378 CRITICAL REVIEW OF CURRENT NUCLEAR SUSPENDED SEDIMENT GAUGES. Rakoczi, L. pp 217-225 of Tracer Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The advantages and disadvantages of available radiometric gages for measuring suspended sediments in rivers and streams are discussed. Suggestions for future developments in sediment gages are given. (TFD)

21379 RECENT PROGRESS IN THE DESIGN OF RADIATION EQUIPMENT AND ITS PRACTICAL IMPLICATIONS. Kirkham, D. (Iowa State Univ., Ames); Corey, J. C. pp 17-39 of Soil-Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agency (1973).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

Giant strides have been made in the past decade in the development of radiation equipment for use in agricultural research. Some of these improvements provide the means for measuring phenomena which could not previously be observed. Use of these new techniques has to a large extent been limited to laboratory experiments, but the techniques are also applicable to field measurements with small design changes. Such changes need to be made, and soil moisture studies moved from the laboratory into the field, so that the theory developed during the last several decades can be evaluated under environmental conditions. (auth)

21380 RADIATION BACKSCATTER MEASURING INSTRUMENT. Hay, W. D. (to Unit Process Assemblies, Inc.). U. S. Patent 3,720,833. 13 Mar 1973. Filed date 10 May 1971. 10p.

A radiation backscatter measuring instrument for use with a portable probe assembly having an elongated casing with an opening at one end thereof and containing a radiation source positioned in predetermined relation therewith and a radiation detector for detecting radiation backscattered from a workpiece exposed to radiation from the source through the casing opening is described. The radiation backscatter measuring instrument includes a planar, horizontally disposed, transparent locator with a series of guide lines on the bottom surface thereof which is positioned over the selected locus of measurement on the horizontally supported workpiece. The locator is then horizontally retracted from its locating position while the portable probe is vertically lowered to engage the workpiece with the opening thereof being positioned over the selected portion of the workpiece to be tested. (Official Gazette)

21381 MODERN COATING THICKNESS GAGES FOR MANUFACTURE AND QUALITY CONTROL. Saak, W. Fachber. Oberflaechentech.; 11: No. 2, 54-56(1973). (In German).

Among others, the β-backscattering method (^{204}Tl, ^{147}Pm, ^{90}Sr, ^{14}C) for the nondestructive measurement of coating thickness is discussed and some applications are presented. (GE)

21382 AIR COLUMN DENSITY VARIATION INSENSITIVE NUCLEONIC GAUGING SYSTEM. Fleming, J. W. Jr. (to Industrial Nucleonics Corp.). U. S. Patent 3,742,218. 26 Jun 1973. Filed Date 31 Jan 1972. 6p.

A nucleonic gauge includes a source in a sealed housing and a spaced detector in which the space between the detector and the pass gap is substantially evacuated, and in which the space between the source and the source window is substantially evacuated to eliminate variations in air density in the air column which otherwise exists between the source and the detector. A standard ion chamber is employed for the detector with a second chamber inserted between the source and the ion chamber which may form part of the collimator which second chamber is pumped to a near vacuum. The arrangement maintains a reasonable spacing between the source and the detector and reduces the effects of vertical deflection on gauge sensitivity. (Official Gazette)

21383 NUCLEONIC GAUGE FOR MEASURING PROPERTIES OF THIN MATERIALS. Hahn, L. K. (to Industrial Nucleonics Corp.). U. S. Patent 3,742,216. 26 Jun 1973. Filed Date 17 Nov 1969. 8p.

A nucleonic gauge for measuring mass, basic weight, or thickness of thin materials such as paper tissue, plastic film or the like has a source head with an annular cavity containing krypton-85 and a beta energy shifting or softening target. The softened reflected beta rays are directed through a centrally positioned aperture and the extent of interaction by the material under measurement in the pass gap is measured by a detector head. The source includes a shutter which forms a portion of the target material in the retracted position of the shutter. The shutter is axially movable into an aperture closing position. The target material is removable and interchangeable for selecting the desired degree of beta softening. Good sensitivity is maintained by reducing the air column in the head and in the detector, and by maintaining a temperature of both heads at substantially that of the material being measured. (Official Gazette)

21384 PARTICLE SIZE ANALYSIS. Starnes, P. E. (to Cartner Group Ltd.). U. S. Patent 3,745,339. 10 Jul 1973. Priority Date 1 Jul 1969, United Kingdom of Great Britain and Northern Ireland. 4p.

In the carrying out of fineness measurements upon a flowing suspension of solids in a liquid by the application of a force field, the flow of the suspension through the apparatus is under a constant head and two or more radiation absorption measurements upon the suspension are made, at least one of which is made subsequent to the application of the force field. From these measurements the fineness of the solids present is deduced, being expressed in terms of the proportion by weight coarser than a given standard sieve mesh. (Official Gazette)

21385 NUCLEAR RADIATION GAUGE STANDARDIZING SYSTEM. Eakman, S. L.; Wood, D. F. (to LFE Corp.). U. S. Patent 3,742,217. 26 Jun 1973. Filed date 18 Jan 1971. 24p.

A nuclear radiation thickness gaging system including a radioactive source and an ion chamber connected through a switching arrangement to a preamplifier is described. The output signal from the preamplifier is a voltage signal having an amplitude representing the detector signal amplitude over the full range of operation. The system is arranged to produce two standardizing full amplitude signals, one for zero absorber conditions and one for maximum absorber conditions. The three signals are used in an output circuit to generate standardized measurement signals representing the thickness of a material being measured. The output circuit in one embodiment is a nulling measurement circuit which utilizes the standardizing signals to adjust the preamplifier characteristic and the system gain. In another embodiment the output circuit is a computer which standardizes the measurement signals mathematically. (Official Gazette)

21386 GAUGE FOR DETERMINING THE PERCENTAGE BY WEIGHT OF MOISTURE CONTAINED IN A BULK MATERIAL TRANSPORTED ON A MOVING CONVEYOR. Chen, Y. M. (to Ohmart Corp.). U. S. Patent 3,748,473. 24 Jul 1973. Filed date 11 May 1971. 22p.

A moisture gage including a radiation source for irradiating with fast neutrons and gamma radiation a bulk substance having moisture contained therein, a detector responsive to gamma radiation which has interacted with a predetermined fractional cross-sectional area of the bulk substance to produce a first electrical signal correlated to the total weight of the bulk substance including contained moisture, and a detector which is responsive to slow neutrons generated by the interaction of fast neutrons and hydrogen atoms of the contained moisture in said predetermined fractional cross-sectional area to produce a second electrical signal correlated to the weight of the moisture contained in the bulk substance is described. An electrical circuit divides the moisture weight signal and total weight signal to provide an output correlated to the percent by weight of moisture contained in the bulk material. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 21402, 22075–22078, and 22092.

21387 (SLA-73-5429) EFFECTS OF GAMMA IRRADIATION ON LSA OSCILLATOR PERFORMANCE. Wilson, W. E. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 11p. (CONF-730828-1). Dep. NTIS $3.00.

From microwave semiconductor devices, circuits and applications conference; Ithaca, New York, USA (14 Aug 1973).

The effects of gamma-produced displacement damage and transient ionization in high peak power LSA diode oscillators were investigated. In the permanent damage case, total gamma dose causes carrier removal at the approximate rate of 4×10^{-3} carriers/cm/photon which leads to an increase in the low field resistance. In addition, both the magnitude of the negative mobility and the velocity peak to valley ratio appear to decrease. These effects lead to an eventual reduction in the device breakdown voltage and an increase in frequency at a fixed bias, similar to those observed for neutron irradiation or temperature. Stabilization and an increase in the breakdown voltage of heavily-doped devices for total doses on the order of 10^7 rads (GaAs) were observed, and appear to be related to a decrease in the magnitude of the negative mobility as borne out by computer simulations. It is concluded that LSA oscillators appear to be immune to gamma irradiation to levels commensurate with most systems requirements. (WHK)

21388 BEAM-DEFOCUSING EFFECT DUE TO FILAMENT MAGNETIC FIELDS IN ELECTRON GUNS OF ELECTRON LINEAR ACCELERATORS. Yamazaki, H.; Ozawa, Y. (Hokkaido Univ., Sapporo, Japan). Jap. J. Appl. Phys.; 11: No. 6, 883-888(Jun 1972).

The effect of filament magnetic fields on the emitted electrons is studied theoretically. It is shown that the effect is equivalent to the increase in the emittances of the output beams and it is not negligible in comparison with the emittances due to thermal motions at the cathodes and those due to the r.f. fields in the bunching sections of electron linear accelerators. (auth)

21389 GUIDE TO THE USE OF SPARK GAPS FOR ELECTROMAGNETIC PULSE (EMP) PROTECTION. Hart, W. C.; Higgins, D. F. Goleta, CA; Joslyn Electronic Systems (1973). 88p.

The effects of electromagnetic pulses (EMP) from nuclear detonations can pose serious problems for unprotected electrical and electronic systems over a wide geographical area. Research on EMP environments, system coupling mechanisms, system response, EMP simulation and testing, and EMP hardening techniques has been in progress for a number of years. The results from this research have provided an understanding of EMP phenomenology and effects and a basis for developing techniques and specifications for the hardening and assessment of critical defense systems. Such techniques include: shielding, cabling, grounding, circuit layout and protective devices. Of the protective devices, spark gaps have been used for lightning and surge protection and in some cases EMP protection in existing missile systems, aircraft, communication command and control networks and power systems. Spark-gap technology has been improving steadily over the last few years and modern gas-tube spark gap protective devices hold the promise for greater application to EMP hardening programs in the future. First, however, engineers and systems designers need a clearer understanding of how spark gaps operate and their design and application features. This information is provided in detail and includes descriptions of the various types of modern spark gap devices, performance information based on EMP level testing, and application and installation procedures. Also included are selected examples of recent applications. (auth)

21390 RESPONSE OF COAXIAL CABLE WITH POLYETHYLENE FILLER TO PULSED RADIATION. Gorbachev, V. M.; Uvarov, N. A.; Gurov, G. A.; Kudrya, V. N. At. Energ. (USSR); 33: No. 1, 576(Jul 1972). (In Russian).

This paper was summarized as paper No. 594/6592 with full copy held by TIC.

Electrical signals appearing in coaxial uncharged cable subjected to bombardment by pulsed neutron radiation and γ-radiation were investigated. The parameters of the high-intensity neutron pulse and γ-ray pulse were as follows: average neutron energy $\bar{E}_n \approx 1.4$ MeV, average γ-photon energy $\bar{E}_\gamma \approx 1.25$ MeV, flux density of neutrons and γ-photons $I_{n,\gamma} \approx 10^{15}$ to 5.10^{16} particles/cm^2 · sec, pulse width at half height $\tau_{\frac{1}{2}} \approx 100$ μsec. Flat spirals of type RK-19 cable, l = 10 m in length, were arranged at right angles to the incident flux at different distances from the source. The results obtained were analyzed within the framework of the electret model. The current in the circuit of the cable core appears to be due primarily to a change in the surface charge of the dielectric $i \approx d\sigma/dt$. The decrease in the current in response to the buildup of the dose is evidence of the buildup and storage of the charge belonging to an electret. The remanent polarization leads to a nonlinearity in the reproduction of the shape of the radiation pulse. Actually, the surface charge density on the polyethylene is comparatively low, because saturation does not occur before the radiation pulse reaches its maximum. This causes the shift in the maximum of the pulse current. Other aspects of the generation of electrical signals in cable in response to a pulse of penetrating radiation are also discussed. (WHK)

21391 INFLUENCE OF RADIATION ON THE SPARKOVER OF SPHERE GAPS AND CROSSED-CYLINDER GAPS STRESSED WITH IMPULSE VOLTAGES. Allibone, T. E.; Dring, D. (Univ. of Leeds, Eng.). Proc. Inst. Elec. Eng. (London); 120: No. 7, 815-821(Jul 1973).

The influence of various forms of radiation on the sparkover characteristics of sphere gaps for 25, 50 and 75 cm-diameter spheres, and of crossed-cylinder gaps for 6.25 and 25 cm-diameter cylinders, has been studied when impulses of both polarities and waveshapes of 1/1000, 1/50 and 80/1000 μs are applied. Radiation improves the accuracy with which the characteristics of such gaps may be determined, and, to achieve an accuracy of better than 1% at all spacings at which each gap would normally be used for impulse-voltage measurement, it is recommended that a radiation source having a strength of the order of 10 mCi be used. (auth)

21392 STATUS OF SILICON SOLAR CELL RADIATION DAMAGE. Curtin, D. J. (COMSAT Labs., Clarksburg, MD); Statler, R. L. pp 682-690 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

During the past 10 y a large number of silicon solar cell irradiation experiments have been performed. These have included 1-MeV and energy-spectrum electron studies and low-energy (a few keV) and high-energy (up to 3 BeV) proton experiments on bare and covered silicon solar cells of several types. In addition, in-orbit data have been obtained from a number of flight-experiment cells as well as from complete solar arrays. At the same time, there has been a concerted effort to develop lithium-doped solar cells to provide radiation-hardened systems. The research that has been conducted is discussed, highlighting the important results and comparing the data on similar cells from different research groups. Gaps and variances in the published data are reported and recommendations for future research are presented. Finally, an extensive list of references is included. (auth)

21393 STUDY OF INTERACTION AMONG SILICON, LITHIUM, OXYGEN, AND RADIATION-INDUCED DEFECTS FOR RADIATION-HARDENED SOLAR CELLS. Berman, P. A. JPL Quart. Tech. Rev.; 3: No. 1, 33-44(Apr 1973).

In order to improve reliability and the useful lifetime of solar cell arrays for space use, a program was undertaken at JPL for development of radiation-hardened lithium-doped silicon solar cells. These cells have been shown to be significantly more resistant to degradation by ionized particles than the presently used n-p non-lithium-doped silicon solar cells. This paper describes the results of various analyses performed to develop a more complete understanding of the physics of the interaction among lithium, silicon, oxygen, and radiation-induced defects. A discussion is given of those portions of the previous model of radiation damage annealing which were found to be in error and those portions which were upheld by these extensive investigations. (auth)

21394 EFFECT OF IONIZING RADIATION ON OPTO-ELECTRONIC SEMICONDUCTOR COMPONENTS. Spencker, A.; Wagemann, H. G. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). NTZ-Nachrtech. Z.; 26: No. 4, 155-160(1973). (In German).

A brief review is given on the radiation resistance, radiation sensitivity, and defect annealing of luminescence diodes, semiconductor lasers, photodetectors, and solar cells. (GE)

21395 RADIATION DAMAGE EFFECTS ON SILICON SURFACE BARRIER NUCLEAR DETECTORS. Chisaka, H. (Tokyo Metropolitan Isotope Research Center). Jap. J. Appl. Phys.; 12: No. 3, 439-444(Mar 1973).

Surface barrier nuclear detectors were irradiated with 1.5-MeV electrons from a Van de Graaff accelerator in vacuum. Changes in performance of the detectors which are strongly related to permanent damage effects on the carrier lifetime and the resistivity of silicon were investigated for various integrated electron fluxes. The results indicate that the reverse current and noise of the detectors increase with increasing integrated fluxes. The theoretical values of the reverse current and noise are estimated by using the changes of bulk parameters and are in good agreement with the experimental values. The increases in the current and noise are mainly caused by the increases in the generation-recombination current and its noise which are related to the irradiation damage effects on the carrier lifetime. Changes in the capacitance are discussed qualitatively. (auth)

21396 EFFECT OF IONIZING RADIATION ON SECOND BREAKDOWN. Pontius, D. R.; Budenstein, P. P.; Smith, W. B. (Auburn Univ., AL). Solid-State Electron.; 16: No. 9. 1073-1077 (Sep 1973).

Constant current pulses, 5 to 100 μsec in duration, with amplitudes sufficient to cause second breakdown in each pulse, were applied to p^+-n-n^+ vertical junction silicon-on-sapphire diodes. The diodes were irradiated on every other pulse by a 20 nsec ionizing radiation pulse from a Nd-glass laser with approximately 4×10^3 rad per pulse. In all cases where the density of carriers generated by the ionizing radiation was greater than the impurity doping density of the most lightly doped part of the test diode, the reverse-bias second breakdown delay time was increased as a result of irradiation. There was no evidence of heating due to laser radiation in any of the test devices up to the threshold of laser damage. (auth)

21397 RADIATION HARDENING READ PREAMPLIFIER. Stehlin, R. A. (to Secretary of the Air Force). U. S. Patent 3,743,955. 3 Jul 1973. Filed date 13 Jul 1971. 4p.

A read preamplifier capable of operation in a radiation environment utilizing self compensation throughout to provide radiation hardness against the effects of photocurrents which are induced by gamma radiation is described. (Official Gazette)

Miscellaneous Instruments

Refer also to abstracts 21005 and 23642.

21398 (BNWL-1751(Pt. 1), pp 59-61) SPECTRAL TRANSFER FUNCTIONS FOR A THREE-COMPONENT SONIC ANEMOMETER. Horst, T. W. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

The transfer functions which describe the effect of line averaging and path separation on the response of a three-component sonic anemometer have been computed specifically for the Kaijo-Denki PAT 311 for tower measurements at Hanford and have been used to facilitate the design of a sensor specifically for use on an aircraft. These computations differ from the previous work of Kaimal, et al. (1968), by accounting for the two parallel paths which compose each measurement axis and for the vertical separation of the two horizontal axes. (auth)

21399 (BNWL-1751(Pt. 1), pp 62-64) AIRCRAFT INSTRUMENTATION FOR THE MEASUREMENT OF TURBULENT WIND FLUCTUATIONS. Horst, T. W.; Busness, K. M. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Instrumentation is being developed for the measurement of the three orthogonal components of the wind from a light, twin-engine aircraft. Aircraft orientation is measured by vertical and directional gyroscopes and aircraft velocity relative to the ground is determined from an orthogonal set of three accelerometers. The velocity of the wind relative to the aircraft will be measured with a nose-boom-mounted sonic anemometer. The aircraft motion system has been flight tested and is operational. The sonic anemometer sensor is currently being designed. It will be constructed and the complete system will be flight tested during 1973. (auth)

21400 (CONF-721091-, pp P14.p1-P14.p9) RADIOISOTOPES IN X-RAY FLUORESCENCE ANALYSIS: A SURVEY OF ITS APPLICATIONS AND POSSIBILITIES. de Jesus, A. S. M. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Energy dispersion x-ray (EDX) spectrometry, where radioisotopes are used in conjunction with suitable radiation detectors, is now becoming very competitive and offers the following advantages over conventional dispersive x-ray systems: simplicity of design and operation, low cost, compact geometry and lightweight instrumentation, and a wide choice of excitation sources which are physically small and easy to handle. Energy discrimination is achieved by means of selective filters, choice of excitation source and electronic pulse amplitude discrimination. The advent of lithium-drifted Si and Ge detectors, with their excellent energy resolution, has had a very large impact in EDX spectrometry. A large variety of combination of radioactive sources, detectors, single and multichannel analyzers, ratemeters, recorders and printers, renders the use of EDX spectrometry very suitable for laboratory work as well as for pilot and process plants. The fact that the samples can be presented in the form of solids, solutions, and slurries makes EDX ideal for on-line analysis. Applications where EDX spectrometry is being used include prospecting and mining operations, monitoring of metallurgical and chemical processes, analysis of alloys, cements, coals and coal ashes, and biological studies. (auth)

21401 (DP-MS-71-41) USE OF ^{252}Cf FOR REACTIVITY MONITORING. Baumann, N. P.; Ahlfeld, C. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 12 Jun 1972. Contract AT(07-2)-1. 17p. (CONF-720607-34). Dep. NTIS $3.00.

From 10th annual American Nuclear Society conference; Las Vegas, Nevada, USA (18 Jun 1972).

A method has been devised and tested whereby the reactivity of an H_2O-moderated fissile array can be monitored by means of a ^{252}Cf neutron source, a neutron detector, and appropriate data acquisition equipment. The ^{252}Cf source is hydraulically oscillated to produce a time-varying neutron flux which approximates a square wave at the fuel-reflector interface. The prompt and delayed neutron response of the fissile array is detected by BF_3 proportional or ^{235}U-lined fission counters. The reactivity is obtained from the prompt-to-delayed neutron ratio and the effective

delayed neutron fraction. Four test arrays were constructed with $0.66 \leq k_{eff} < 0.97$, and several k_{eff} measurements were obtained for each array with various source-detector geometries. The results are compared with diffusion group theory calculations and pulsed neutron measurements using a Texas Nuclear Corp. neutron generator. Agreement is good in the more reactive cases. The uncertainty in the measurements for the least reactive case is improved substantially if obviously poor source-detector geometrics are avoided. Finally, the relative merits of ^{252}Cf and standard accelerator-type neutron sources are investigated with respect to application as a reactivity monitor. (auth)

21402 (GULF-GA-A-12501) EMF DRIFT OF CHROMEL/ALUMEL AND W–3% Re/W–25% Re THERMOCOUPLES MEASURED IN-PILE TO HIGH NEUTRON EXPOSURES. Sandefur, N. L.; Steibel, J. S.; Grenda, R. J. (Gulf General Atomic Co., San Diego, Calif.). 24 May 1973. Contract AT(04-3)-167. 22p. (CONF-730611-15). Dep. NTIS $3.25.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

A method for calibrating thermocouples in-pile during operation at high temperatures was devised whereby periodic calibration of test thermocouples could be done. Chromel/Alumel and W–3% Re/W–25% Re sheathed thermocouples were tested while operating continuously at average temperatures of 925° and 1100°C. An internal calibration system using the melting point of copper (1083°C) as a standard was used to measure emf output deviations. The irradiation experiment, which contained two thermocouple calibration cells, operated at test temperature in the 175-75 MW Engineering Test Reactor for 6200 hr during a period of 16 months. The accumulated neutron fluences for the W–3% Re/W–25% Re thermocouples were: 4.5 and 5.6×10^{21} n/cm^2 (thermal and fast) while operating at an average temperature of 1100°C and 5.3 and 7.8×10^{21} n/cm^2 (thermal and fast) while operating at an average temperature of 925°C. The accumulated neutron fluences for the Chromel/Alumel thermocouples were 2.8×10^{21} n/cm^2 (thermal) and 4.1×10^{21} n/cm^2, E > 0.18 MeV (fast), while operating at an average temperature of 925°C for 2960 hr. The emf output of the Chromel/Alumel thermocouples did not change during the experiment. The emf output of the W–3% Re/W–25% Re thermocouples decreased to ~63% of the standard value after a thermal neutron exposure of 5.3×10^{21} n/cm^2. The reduction in output as a function of thermal fluence can be expressed by the function T actual = T indicated $(1-0.116\ F + 0.0086\ F^2)^{-1}$. Transmutation of the tungsten to rhenium and rhenium to osmium by thermal and epithermal neutrons was postulated as the major cause for the decrease in emf output. The results appeared to be independent of the two test temperatures. (auth)

21403 (KFK-1813) CAMAC DATA LOGGING SYSTEM. Friedle, T.; Heep, W.; Stiefel, W. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jun 1973. 37p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

A data logging system containing an integrating analog-to-digital converter and a multiplexer with 256 channels is described. Relays with mercury wetted contacts are used. Filter networks can be attached if needed. The system performance is 25 conversions per second. The ADC control unit features random access, block, and scan mode. An auxiliary multiplexer is provided to switch voltage/current to passive transmitters (e.g., resistance thermometers). This switching is done 120 msec in advance of the conversion to allow a transient settling time without reduction in conversion rate. (GE)

21404 (LA-5302-MS) PROGRAMMING THE MBD MODEL I. Thomas, R. F. Jr. (Los Alamos Scientific Lab., N. MEX). Jul 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

The LAMPF Microprogrammed Branch Driver (MBD) is described from a programmer's point of view; and a set of macro-instructions, implemented in the PDP-11 MACRO assembler, suitable for writing programs for it, is described. (auth)

21405 (SLA-73-727) FINAL REPORT ON EVALUATION AND CALIBRATION OF TRANSDUCERS FOR MEASURING STRESSES OF UP TO TWO KILOBARS IN GROUT AND CELLULAR CONCRETE. Harvey, P. J.; Bickle, L. W. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 25p. Dep. NTIS $3.00.

Three types of pressure transducers were selected for use in a recent underground nuclear test to measure stresses of up to 2 kbar in grout and cellular concrete. The pressure transducers (2 passive and 1 active) were calibrated and evaluated in both bare and embedded configurations and in both static and dynamic loading conditions to 2 kbar of pressure. The embedding materials were rock matching grout and cellular concrete. Comparisons between static and dynamic loading calibrations were made as were comparisons between bare and embedded calibrations. Two types of signal conditioners for the active gage were evaluated. The conditioner types were a Natel carrier demodulator unit and an Endevco dc unit. A recommendation was made on which passive gage type was better based on reliability, ease of use, ease of calibration, and accuracy. (auth)

21406 SIMPLE NEUTRON GUIDE TUBE AND DIFFRACTOMETER FOR SMALL-ANGLE SCATTERING OF COLD NEUTRONS. Haywood, B. C. G.; Worcester, D. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., E (London); 6: No. 6, 568-571(Jun 1973).

A neutron guide tube and diffractometer for measurements of small-angle Bragg diffraction are described. Application to studies of biological structures is demonstrated by preliminary diffraction data from the membranes of the myelin sheath of dog sciatic nerve. (auth)

21407 COUNT RATE DISCRIMINATOR. McCoy, D. D.; Shue, B. H.; Gutmacher, R. G. (to United States Atomic Energy Commission). U. S. Patent 3,737,789. 5 Jun 1973. Filed date 21 Dec 1971. 6p.

A count rate discriminator which detects pulsed input signals having a pulse repetition rate within a selectable lower and higher pulse rate limit and which passes, during a predetermined time period, only those input pulses contributing to exceed the preselected low limit pulse rate providing said input pulse rate does not exceed the preselected high limit is described. (Official Gazette)

21408 LOW BACKGROUND SECONDARY ION MASS SPECTROMETER WITH QUADRUPOLE ANALYZER. Wittmaack, K.; Maul, J.; Schulz, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Munich). J. Mass Spectrom. Ion Phys.; 11: No. 1, 23-35(Mar 1973).

A simple secondary ion mass spectrometer has been developed to allow trace analysis at impurity concentrations down to the parts per billion range. The spectrometer consists of an aperture bounded plate capacitor followed by a quadrupole mass filter with an off-axis detector. This arrangement allows suppression of sputtered neutrals and high-energy sputtered or backscattered ions which otherwise produce a high background intensity of more than 1% of the target peak intensity in our set-up. After optimization of the geometry of the plate capacitor an intensity ratio of peak to background of 2×10^3 could be obtained for an aluminium specimen. The capability of the arrangement is demonstrated by trace analysis of boron in silicon. The process of background formation by neutrals and high energy ions is studied and discussed. (auth)

21409 SIMPLE DEVICE FOR MAGNETIC FIELD CONTROL. Ross, W. G. (Scottish Research Reactor Centre, East Kilbride, Glasgow). J. Mass Spectrom. Ion Phys.; 11: No. 4, 393-398 (Jun 1973).

A device is described which provides a stable and inexpensive means of monitoring and/or controlling magnetic fields. Its range of operation makes it particularly suitable for inclusion in the main magnetic field of a mass spectrometer where its output may be used as an indication of mass or if used in a feedback loop, to precisely control the field of the magnet. The thermal stability of the device over the range 0 to 100°C is better than 50 ppM per °C and resetability is in the order of one part in 100,000. (auth)

21410 DOUBLE-FOCUSING DOUBLE-COLLECTING MASS SPECTROMETER FOR LIGHT STABLE ISOTOPE RATIO ANALYSIS. Coplen, T. B. (Univ. of California, Riverside). J. Mass Spectrom. Ion Phys.; 11: No. 1, 37-40(Mar 1973).

Modification of a Dupont 21-491 double-focusing mass spectrometer for carbon dioxide isotope ratio analysis has resulted in a decrease in the mass-44 tailing by approximately 50-fold and an increase in signal-to-noise ratio. Consequently, tailing corrections have been made negligible. (auth)

21411 DISCRIMINATION IN ELECTRON MULTIPLIERS FOR ATOMIC IONS. II. Comparison of Yields for 61 Atoms. Pottie, R. F. (National Research Council, Ottawa); Cocke, D. L.; Gingerich, K. A. J. Mass Spectrom. Ion Phys.; 11: No. 1, 41-48 (Mar 1973).

The relative multiplier yields for the atomic ions reported in Part I are compared with those available in the literature and with additional data. Yields for 62 atoms are reported. Reproducibility is good among different investigators despite the variation in experimental apparatus and operating conditions. Various attempts are made to relate yields to physical properties of the atoms, and an empirical correlation is suggested. It is shown that the following error limits can be expected for atomic ion multiplier yields: (1) directly measured ±5%, (2) values taken from the literature ±10%, and (3) values derived from our normalization curve ±20%. (auth)

21412 MASS SPECTROMETER ION SOURCE FILAMENT LIFETIMES IN THE PRESENCE OF OXYGEN. Mauersberger, K.; Olson, D. H. (Univ. of Minnesota, Minneapolis). J. Mass Spectrom. Ion Phys.; 11: No. 1, 72-74(Mar 1973).

Measurements of the composition of the neutral upper atmosphere have been made using mass spectrometers on rockets and satellites. The ambient particles are usually ionized in an electron beam emitted from a heated tungsten filament. While a rocket flight only lasts for a few minutes, a satellite experiment is expected to obtain data for a period of a year or more. In the presence of an oxygen atmosphere, the lifetime of the ion source filament becomes a critical factor. Because of the limited power available on a satellite, the smallest possible filament that would still be reliable is desirable. Two new satellite projects with mass spectrometers on board are planned. One requires measurements under high pressure in the thermosphere, and the other requires long duration measurements in the exosphere. In both missions, oxygen in either atomic or molecular form will be one of the major constituents. Therefore, it was necessary to determine the expected deterioration rates of the ion source filaments prior to launch. The filament material selected was an alloy of 97% tungsten and 3% rhenium. This particular material was chosen because of the reliability that it has shown in the laboratory and on rocket-borne mass spectrometers. When heated, the filaments may be expected to deteriorate due to two processes: evaporation of metallic tungsten, and oxidation of the filament in the presence of oxygen. Test results showing the filament lifetime in the presence of oxygen versus filament diameter are given. (TFD)

21413 DEVELOPMENT OF FISSION GAS PRESSURE MEASUREMENT TECHNIQUE IN THE JMTR. Tanaka, I.; Onodera, K. (Japan Atomic Energy Research Inst., Oarai, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 5, 309-319(May 1973).

To measure the gas pressure in fuel pins during irradiation, a null-balance type pressure sensor embodying bellows and a self-regulating apparatus was devised. An innovation applied to the device was the method of sealing with alumina plug the end of the mineral-insulated cable constituting the lead wire for conveying the signals from the pressure sensor. After verifying by out-of-pile tests that the gas pressure could be measured up to 70 kg/cm^2 G, with error within ±2.4%, an irradiation capsule was prepared in which a fuel pin containing UO_2-pellets and the pressure sensor were accommodated. The capsule was irradiated during three cycles of JMTR operation. The pressure sensor and the controller worked satisfactorily, the gas pressure being recorded through the three cycles of reactor operation. The applicability of this technique to practical measurements of gas pressure in fuel pins was thus established. (auth)

21414 X-RAY CONVERSION SCREEN UTILIZING YTTRIUM OXYSULFIDE PHOSPHOR. Masi, F. (to United States Radium Corp.). U. S. Patent 3,738,856. 12 Jun 1973. Filed date 11 Jan 1972. 8p.

An x-ray conversion screen comprises a substrate sheet having on a surface thereof a phosphor coating consisting essentially of at least 5% by weight of yttrium oxysulfide activated with from 0.1% to 10% by weight of terbium or a mixture of terbium plus dysprosium. Up to 95% by weight of the phosphor coating may be (a) gadolinium, lanthanum or lutetium oxysulfide phosphor activated with terbium or a mixture of terbium plus dysprosium, (b) barium phosphate activated with divalent europium, (c) calcium tungstate, (d) zinc sulfide or zinc cadmium sulfide activated with copper or silver, or (e) barium lead sulfate. (Official Gazette)

21415 TWO MODE HIGH SPEED TIME ANALYZER WITH PLATED WIRE MEMORY. Kimura, I. (Kyoto Univ.). Nucl. Instrum. Methods; 111: No. 1, 169-179(1973).

A 1024 channel high speed time analyzer was made by using a plated wire as a memory element. This time analyzer has two operation modes, TOF mode (add-one mode) and MS mode (multi-scaler or add-N mode), both of which use a 133 MHz crystal oscillator. The channel width of the former mode can be selected from 15 ns to 3.84 μs (9 stages) and that of the latter from 1 μs to 65.536 ms (9 stages). For background counting, the last eight channels have longer channel widths and selective delays. These channel widths and delay times were tested with random pulses from a liquid scintillation counter and a weak radioactive source, and periodic pulses from a pulser. The results agreed satisfactorily with the designed values. The dead time for the TOF mode was found to be about 270 ns and that for the MS mode was about 19 ns in counting and about 250 ns in memory cycle. These values are drastically shorter than previous time analyzers, such as TMC-211. This time analyzer has been applied to fast neutron time-of-flight experiments with an electron linear accelerator, and pulsed neutron experiments in beryllium–oxide piles. In this case, no correction for count losses by dead time of a time analyzer is required. (auth)

21416 THERMALLY BENT IDEAL CRYSTALS AS MONOCHROMATORS FOR NEUTRON SCATTERING. Kalus, J. (Munich Technische Univ., Garching, Ger.); Gobert, G.; Schedler, E. J. Phys., E (London); 6: No. 5, 488-492(May 1973).

The theoretical behavior of ideal bent single crystals used for the monochromatization of neutrons is deduced. A device, producing a temperature gradient across the single crystal for maintaining the bending, is described. Experimentally a radius of curvature of 500 cm, a reflectivity of 45% for neutrons with a wavelength of 1.37 Å and an effective mosaic angle of 8° was achieved for a CaF_2 single crystal with dimensions 5 cm × 10 cm × 0.5 cm. (auth)

21417 NEUTRON GUIDE TUBE WITH CIRCULAR CROSS SECTION: PRINCIPLES OF CONSTRUCTION AND MEASURED PROPERTIES. Schaerpf, O.; Eichler, D. (Technische Univ., Brunswick). J. Phys., E (London); 6: No. 8, 774-780(Aug 1973).

A simple and inexpensive neutron guide tube is described. Curves for the easy determination of the characteristic wavelength, spectral maximum, and neutron current distribution at the exit of the tube are presented. The method of mounting and alignment of the single tube and results for two different guide tubes in comparison with calculations are reported. (auth)

21418 APPLICATION OF LINEAR COMPENSATION IN X-RAY SPECTROMETRY. Plesch, R. (Siemens AG, Karlsruhe, Ger.). G-I-T (Glas- Instrum.-Tech.) Fachz. Lab.; 17: No. 7, 677-683(1973). (In German).

The linear compensation of a standard measurement series can be performed by three methods: (1) graphically, (2) by regression calculation without regard to the deviations of the measured values, and (3) by regression calculation with regard to the deviations of the measured values. The procedures given are treated and discussed by examples. If the analytical error is only of interest in an approach, the performance of the procedure (3) is indispensable. For a separately measured background a particularly simple procedure is possible. A criterion for the determination of the detection limit is given. If this criterion is not fulfilled this determination will be somewhat dubious. (GE)

21419 INVESTIGATION OF THE DECELERATING FIELD OF AN ELECTRON MULTIPLIER UNDER NEGATIVE ION IMPACT. Larsen, E.; Kjeldgaard, K. (Danish Atomic Energy Commission Research Establishment, Risoe). J. Mass Spectrom. Ion Phys.; 11: No. 2, 149-155(Apr 1973).

The effect of the decelerating field of an electron multiplier towards negative ions was investigated under standard mass spectrometric conditions. Diminishing of this decelerating field by changing of the potential of the electron multiplier increased the overall sensitivity to negative ions by a factor of 100. The secondary electron emission coefficient for the negative halogen ions relative to I^- was measured on CuBe at the kinetic energies 1.0 and 1.5 keV. (auth)

21420 REMOTE CONTROL UNIT FOR A ND-2020 MULTICHANNEL ANALYZER. Torok, I. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 1, 59-60(1973). (In Hungarian).

In order to carry out serial measurements with the neutron generator of the Institute for Atomic Research, it was found necessary to make rapid changes in the operating mode. This was achieved by using signals from the detector for automatic switching of the analyzer. A "Spectrascaler" instrument and a "Clock/Time-Base" timer, started by a signal from the photodiode supplemented the analyzer. The voltage-jump signal was entered through the monostable Schmitt trigger input of the integrated circuit by means of a transistorized inverter stage. Operational details of the system are described. (TTT)

21421 TRIAL MANUFACTURE OF THE MONOPOLE SPECTROMETER. Tanaka, T.; Hirao, K. (Tokyo Univ.). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 2, 317-322(Apr 1973). (In Japenese).

The monopole spectrometer using rf electric field was manufactured for testing. The parameters of the analyzing field are as follows: 25 cm field length, 4.3 mm field radius and 3.3 MHz fixed frequency. Mass scanning is accomplished by amplitude variation of rf and dc voltages which are added to the spectrometer while maintaining UV ratio constant. Dependences of resolution and relative sensitivity on UV ratio and ion acceleration voltage are investigated. It is shown that the monopole spectrometer can achieve good resolving power with a wide range of UV ratio. (auth)

21422 POLE SHAPES FOR QUADRUPOLE MAGNETS HAVING CIRCULAR POLE TIPS. Kobayashi, M. (Tokyo Univ., Tanashi, Japan). Jap. J. Appl. Phys.; 11: No. 1, 47-54(Jan 1972).

Harmonic field contents of quadrupole magnets having circular pole tips of various radii R_p's and rectangular coil slots at various distances L_{cut}'s from the centre are numerically calculated by using two dimensional scalar potentials. The optimum radius of circular pole tip varies from 1.0088 to 1.1374 times the gap radius R_g as L_{cut} from 0.8 to 1.4 times R_g. Designs of optimum pole shapes for drift tube quadrupole magnets are discussed from harmonic field content, available coil space, core saturation and problems in fabrication. Flat poles as a limit of large pole tip radii were also calculated. A few measurements are compared with the calculations. (auth)

21423 FACILE CRYOSTAT FOR NEUTRON DIFFRACTION EXPERIMENTS. Hirakawa, K.; Ikeda, H. (Tokyo Univ.). Jap. J. Appl. Phys.; 11: No. 1, 82-84(Jan 1972).

A facile conduction-type cryostat for neutron diffraction experiments was designed. This portable cryostat is much easier to operate than the conventional type. Liquid helium of about 2 liters can stay for fifty hours or more. The cryostat may be used at any temperature between room temperature and 4.2°K. (auth)

21424 PROPOSAL ON MULTIPLY CHARGED ION SOURCE. Tamagawa, H.; Okamoto, Y.; Akutagawa, C. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 11: No. 8, 1226-1227(Aug 1972).

21425 DETECTION OF ATOMIC BEAMS USING A COMMERCIAL RESIDUAL GAS ANALYZER. English, T. C. (Department of Physics & Astrophysics, Duane Physical Laboratories, University of Colorado, Boulder, Colorado 80302); Pernicka, J. C. Rev. Sci. Instrum. 44: No. 2, 230-230 (Feb 1973).

The detection efficiency of a high sensitivity, commercial, residual gas analyzer, when used as an atomic beam detector, has been experimentally determined to 5.5×10^{-6} for a thermal beam of argon atoms. (auth)

21426 OPTIMAL USE OF DOUBLE PIN IONIZATION GAUGES FOR SHOCK WAVE DETECTION. McClenahan, J. O. (Ames Research Center, NASA, Moffett Field, California 94305). Rev. Sci. Instrum. 44: No. 2, 212-214 (Feb 1973).

Quantitative use of a high speed shock tube depends upon the ability to detect the time of arrival of the shock wave at a given position, with a resolution of 1 μsec or better so that (1) the velocity of the shock wave can be determined and (2) the various instruments attached to the shock tube can be triggered or energized at the proper time. Of the many types of gauges available for detecting the arrival of a shock wave at a given point, ionization gauges are the simplest and are capable of producing higher signal levels without the use of complicated electronic circuitry. For these reasons ionization gauges are usually the preferred shock wave detectors. Their use has been limited, however, by the fact that the range of shock tube operating conditions at which they perform satisfactorily is small. This paper describes a new method of using ionization gauges by systematically adjusting the electronic circuitry to allow for large ranges in shock tube operating conditions. This method should be useful in various applications where ionization gauges are used to detect shock waves. (auth)

21427 THE CALIBRATION OF ELECTROSTATIC ANALYZERS AND CHANNEL ELECTRON MULTIPLIERS USING LABORATORY SIMULATED OMNIDIRECTIONAL ELECTRON BEAMS. Arnoldy, R. L.; Isaacson, P. O.; Gats, D. F. (Space Science Center, University of New Hampshire, Durham, New Hampshire 03824); Choy, L. W. Rev. Sci. Instrum. 44: No. 2, 172-176 (Feb 1973).

The difficulty of obtaining accurate calibrations of electrostatic analyzers employing large aperture channel electron multipliers is discussed. This is due primarily to the varying efficiency of large aperture multipliers depending on point and angle of impact on the aperture. This varying response makes the assignment of an over-all detector efficiency uncertain by at least a factor of 2. A laboratory calibration scheme is discussed by which the combined efficiency and geometry factor is obtained for flight detectors using a simulated omnidirectional source of particles. (auth)

21428 TRANSITION REGION RESPONSE OF THE SYMMETRIC DOUBLE PROBE AND ITS APPLICATION IN THE LOWER IONOSPHERE. Szuszczewicz, E. P. (Laboratory for Planetary Atmospheres, National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland 20771). Rev. Sci. Instrum. 44: No. 2, 115-119 (Feb 1973).

The technique of the symmetric double probe lends itself to the in situ measurement of plasma temperature in the ionospheric D region because it can lead to meaningful results under relatively high collision frequencies where the Langmuir probe has been observed to fail. For a completely thermalized plasma and over parametric ranges $0.1 \leq \lambda_m/R_p \leq 100$ and $0.004 \leq R_p/\lambda_D \leq 100$, where λ_m is the ion-atom mean free path, R_p is the probe radius, and λ_D is the Debye length, it is shown that the modification to the original collision-free double-probe theory of Johnson and Malter for the determination of electron temperature is never greater than 12%, with a value of (8±2) % nominally applicable in the case of D-region diagnostics. This technique has been successfully operated on a Nike-Cajun payload flown at midday from White Sands, N. M. to an apogee of 78.5 km. The associated electronics and deployed double-probe configuration are presented, and a current-voltage characteristic collected in the ascent stage at 73.7 km is briefly discussed. The values of electron temperature indicated by the sampled data are ≈30% higher than those predicted by theory for the anticipated state of thermal equilibrium with the ambient neutrals. The importance, however, is that these values, of the order of 300 K, are the lowest ever reported by any in situ method operative in the D region and consequently point out the strong potential of the double-probe technique in future applications to regions of planetary ionospheres which cannot be considered as collision-free. (auth)

21429 ION LENS SYSTEM FOR MASS SPECTROMETERS AND METHOD OF OPERATION. Halliday, J. S.; Evans, S. (to Associated Electrical Industries Ltd.). U. S. Patent 3,745,343. 10 Jul 1973. Priority date 7 Nov 1969, United Kingdom of Great Britain and Northern Ireland. 10p.

An ion lens system which may be utilized with a mass spectrometer for varying the width of an ion beam entering or leaving the analysis region of the spectrometer, and method of operation thereof are described. The lens system includes a plurality of apertured ion lenses which may be positioned between an ionization chamber and the analysis region of the spectrometer, or alternatively, may be positioned between the analysis region of the spectrometer and the collector. By varying the potentials applied to the ion lenses, the effective widths of the apertures may be altered in order to vary the width of the ion beam. (Official Gazette)

21430 ION SOURCE HAVING IMPROVED ION BEAM ALIGNMENT AND FOCUS STRUCTURE. Gutow, R. S. Jr. (to Varian Associates). U. S. Patent 3,742,275. 26 Jun 1973. Filed date 4 Mar 1971. 4p.

An ion source for a mass spectrometer comprising a plurality of components arranged along the ion beam path including a source body, repeller and extractor electrodes, a lens structure including an alignment electrode and a focus electrode, and an aperture plate is described. Certain of the components are made from common parts including the alignment and focus electrodes, each of which is formed by a metallic disk having a rectangular aperture centrally disposed therein but located slightly off axial center. The two electrodes are mounted along the beam path so that the two apertures are off-set in mutually opposite directions. Only a portion of the aperture of each electrode is aligned along the beam axis through which the beam passes for alignment and focussing. (Official Gazette)

21431 METHODS AND SYSTEM FOR DETECTING SUBSURFACE MINERALS. Scott, H. D.; Maute, R. E. (to Texaco Inc.). U. S. Patent 3,752,984. 14 Aug 1973. Filed date 2 Dec 1971. 14p.

An improved radiological borehole logging system for detecting sulfur in cased or uncased boreholes is described. The earth around the borehole is irradiated with neutrons, and pulses are generated which are representative of the number and energies of the resulting secondary gamma radiations. The pulses are sorted into a first group comprising a high energy range of gamma rays including sulfur-emitted gammas, and a second group comprising a lower energy range of gammas including those emitted by nuclei of calcium, silicon, chlorine and iron. The energy ranges are chosen so that the ratio of the count rates of these two groups will be substantially constant unless the irradiated formation happens to contain a significant number of sulfur nuclei. Accordingly, a change in the ratio may be taken as an indication of the presence of a sulfur-bearing formation, and the magnitude of the change will be functionally related to the relative proportion of sulfur in the formation. (Official Gazette)

21432 METHOD OF MANUFACTURING A RADIATION-SENSITIVE ELECTRONIC DEVICE. te Velde, T. S. (to United States Philips Corp.). U. S. Patent 3,729,342. 24 Apr 1973. Priority date 1 Apr 1970, Netherlands. 4p.

A method of providing a radiation-permeable contact layer in good electrical contact with radiation-sensitive or electroluminescent grains is described. The grains are spread on a metal layer which is situated on a radiation-permeable conductive layer, and upon heating in the melted condition the melted metal of the metal layer is drawn by capillary action to between the grains and the permeable conductive layer and the space between the grains is then filled with a polyurethane. (Official Gazette)

21433 ULTRASONIC TRANSDUCER ASSEMBLY. Wade, F. (to United Kingdom Atomic Energy Authority). British Patent 1,320,915. 20 Jun 1973. Filed date 29 Oct 1969. 3p.

Reference is made to ultrasonic transducer assemblies suitable for supplying a number of probes located remote from the assembly with ultrasonic pulses for the purpose of measuring changes of temperature. Ultrasonic techniques are suitable for measuring temperatures within nuclear reactors and for this purpose can show advantages over thermocouples. The assembly described comprises a mounting block supporting a permanent magnet, a number of magnetostructure members polarized by the magnet and disposed around the magnet on a common circle, the axis of which coincides with the axis of the magnet. These members are equispaced, and each is electromagnetically coupled to a separate coil encircling the member so that part of the coil is located between the member and the magnet. (UK)

21434 USE OF AN ADIABATIC CALORIMETER FOR MEASUREMENTS ON NUCLEAR FUEL SAMPLES: ITS UTILIZATION FOR MEASURING SPECIFIC BURN-UPS. Ramthun, H. (Physikalisch Technische Bundesanstalt, Brunswick). Rev. Gen. Therm.; 12: No. 137, 469-472(May 1973). (In French).

From 4th meeting on calorimetry and differential thermal analysis; Paris, France (4 May 1972).

A method is presented for determining the specific burnup of an irradiated fuel from measurements made of the quantity of heat released using an adiabatic calorimeter. The calorimeter receives the energy radiated from the nuclear fuel in such a way that all of the energy released (kinetic energy of α and β particles, and quantum energy of γ rays, x rays, and bremsstrahlung) is converted into measurable heat. A comparison with gamma ray spectrometry methods demonstrates the efficiency of this nondestructive method. (FR)

21435 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS. Evans, S.; Halliday, J. S. (to Associated Electrical Industries Ltd.). British Patent 1,318,200. 23 May 1973. Filed date 7 Nov 1969. 7p.

Mass spectrometers of the magnetic analyzer type are described. An object of the instrument is to provide a construction in which the width of ion beam entering and/or leaving the analysis region may be adjusted without the difficulties associated with mechanically adjustable slits. A zoom lens system is employed, comprising two ion lenses associated with a slit for passage of the ion beam. This lens system is arranged to vary the effective width of the slit by changing the overall magnification of the system. In a preferred arrangement separate source and collector slits are provided, each with an associated zoom lens system, so that the width of ion beams entering the analysis region and that leaving may be separately adjusted. Each of the ion lenses is preferably formed by a number of apertured elements through which the ion beam is arranged to pass and means are provided to supply variable potential to at least one element of each lens to control the magnification. (UK)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 22123 and 22210.

21436 (COO-3127-2) ANALYSIS OF TRANSIENT BEHAVIOR OF A SQUARE CASCADE OF CLOSE-SEPARATION STAGES. Ishida, T.; Wieck, H. (Brooklyn Coll., N. Y.). [nd]. 28p. (CONF-730651-1). Dep. NTIS $3.50.

From isotope effects in physical and chemical processes meeting; Cluj, Romania (25 Jun 1973).

The behavior of a square cascade of close-separation stages under total reflux was studied to extend applicability of K. Cohen's theory. Cohen's tables for the long-time kinetics has been extended to include a larger overall separation as well as the stripping section. The second transient term of long-time kinetics has been evaluated. Inclusion of the second term extends the applicability of the kinetics to a much shorter time of operation than is possible when only one term is used. The equilibrium time was calculated for various conditions. It is easier to obtain a shorter start-up period when the desired isotope enriches in a gas phase rather than in a condensed phase. (auth)

21437 (FOA-4-4548-A-1) URANIUM ENRICHMENT: YESTERDAY, TODAY, TOMORROW. Wallin, L. B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Jul 1973. 76p. (In Swedish). Dep. NTIS (U.S. Sales Only) $5.75.

In the first part of the report a survey is given of the enrichment procedures for uranium. In the second part the existing enrichment plants are described as well as national and international plans of new plants. The third part deals with construction and operation costs of the main alternatives of future commercial plants—gas diffusion and gas centrifugation as well as the German separation nozzle process. The future of earlier methods as well as suggested chemical, laser and plasmaphysical methods is treated briefly. (SW)

21438 (K-Trans-71) VII. ENRICHMENT. 1971. Translation of pp 87-91 from JUL-827-HT. 6p. Dep. NTIS $3.00.

The demand, supply, capacity, and cost aspects of enriched uranium for West German power reactors to the year 1985 are discussed in terms of planned separation production in the U. S. The possibility of German utilities having cost-plus enrichment performed in the USSR is mentioned. (LCL)

21439 (ORNL-tr-2673) STUDY OF ISOTOPIC CONTAMINATION WITH THE TWO-STAGE MAGNETIC SEPARATOR AT GRENOBLE. Boge, M. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Aug 1970. Translated by L. T. Newman (Oak Ridge National Lab., Tenn.), from CEA-R-4043. 64p. Dep. NTIS $5.25.

The causes of isotopic contamination in the Grenoble separator were studied to determine the best operating conditions and its performance limitations. The first part of the report is devoted to the study of scattering by the residual gas and the second part to the phenomenon of chromatism analyzed by a third electrostatic stage. (TFD)

21440 COMPUTERIZED MASS SPECTROMETER CONTROL OF A THERMAL DIFFUSION PLANT FOR ISOTOPE SEPARATION. Yinon, J.; Ashkenazi, Y.; Gilath, C.; Meri, M.; Grinberg, M. R.; Wolf, D. (Weizmann Inst. of Science, Rehovot, Israel). Chem. Instrum.; 4: No. 4, 255-268(1972).

An automatic control system for an isotope separation plant has been operated. The separation plant consists of thermal diffusion columns for isotope separation of oxygen and krypton. A quadrupole mass spectrometer, operating under computer control, is used to analyze the gas streams from the thermal diffusion columns. The results are fed back by the computer to the columns to automatically control the production of enriched isotopes of oxygen and krypton. (auth)

21441 STUDIES ON A GAS CENTRIFUGE FOR ISOTOPE SEPARATION. Pressure Distribution in a Rotating Cylinder. Takashima, Y. (Tokyo Inst. of Tech.); Saito, K.; Endo, Y.; Saito, M. Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 116, 65-77(Mar 1973).

A simple analysis on the pressure distribution in a gas centrifuge was studied for the case in which the flow is slowly moving in the radial direction in a rotating cylinder. The solution seems to be valid if there is no baffle in a cylinder, as it showed good agreement with the experimental results. According to the analytical solution, the pressure distribution varies with not only the angular velocity but also the feed rate, the viscosity and the positions of feed and discharge in a rotating cylinder. Therefore, the characteristics of isotope separation should also vary with the position of feed or discharge and a few experimental demonstrations of this effect have been done by using SF_6 gas. (auth)

21442 INFLUENCE OF GEOMETRIC PARAMETERS ON THE PERFORMANCE OF SEPARATING NOZZLE ELEMENTS IN URANIUM 235 ENRICHMENT. Weis, F. Karlsruhe, Ger.; Univ. Karlsruhe (1971). 39p. (In German).

Thesis.

The parameters influencing the separating properties of separation systems were studied. These parameters were nozzle width, height setting of the nozzle plate, skimming width, height setting of the skimmer blade edge, as well as the shapes of the inlet edge of the deflection groove and of the skimmer blade edge. The accurate observation of these parameters is of great importance for the technical fabrication of the separating elements as their costs related to the overall costs of the product are largely dependent on the required tolerances. (GE)

21443 REACTIONS TO OFFERS OF ENRICHED URANIUM TO GERMANY ON THE PART OF THE CEA AND URENCO. Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 60-65(May 1973). (In Italian).

The French CEA and the British-German-Dutch society Urenco have both offered enriched uranium to West Germany. The CEA offer sparked controversy. The area of controversy is discussed. The question of whether the CEA can fulfill its offer is considered. (JSR)

Isotopic Power Sources

Refer also to abstracts 20895, 20897, 20900, 20954–20956, 21050, and 21977.

21444 (ARCO-3057-14) QUARTERLY PROGRESS REPORT FOR RADIOISOTOPE POWERED CARDIAC PACEMAKER PROGRAM, MAY 1–JULY 31, 1973. (Arco Nuclear Co., Leechburg, Pa.). 1973. Contract AT(11-1)-3057. 41p. Dep. NTIS $4.00.

Progress during May to Aug. 1973 in developing a radioisotope powered cardiac pacemaker is reported. Thirty-six units so far implanted in humans are performing effectively. Twenty-nine of 30 units implanted in dogs continue to operate properly. One such unit was removed and showed a defect in the initial assembly of the nuclear battery. Experimental model life testing continued. Five more units were sterilized making a total of 55 units sterilized for human implants. Tabulated data are presented on modified production model life tests; qualification testing of production batteries; qualification testing of pre-production and production units; quarterly inspection of components; unit production; performance of units assembled in May; human implants; human pulse rates; dog pulse rates; and testing of temperature indicators during actual cremations. (LCL)

21445 (CEA-R-4447) RADIOISOTOPIC CARDIAC PACEMAKER REPORT ON SAFETY TESTS: CRUSH, INTERNAL PRESSURE, CREMATION. Carrard, C.; Milet, C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar 1973. 55p. (In French). Dep. NTIS (U.S. Sales Only) $4.75.

Various tests such as crush and internal pressure resistance of the radioisotopic sources as well as cremation at 1300°C performed on the sources, the thermoelectric batteries, and the whole cardiac pacemaker are described. (auth)

21446 (DP-1338) SAVANNAH RIVER LABORATORY COBALT-60 POWER AND HEAT SOURCES. Final Quarterly Progress Report, April–June 1973. Angerman, C. L. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Aug 1973. Contract AT(07-2)-1. 22p. Dep. NTIS $4.00.

This report is the last in this series of Quarterly Progress Reports. The highlights of the SRL ^{60}Co Heat Source Program, which began in FY 1966, are summarized chronologically as an informal index to the progress reports on this work. Satisfactory performance for up to 48,000 h at 850 to 1000°C was demonstrated with seven superalloy capsules containing unirradiated cobalt metal. Performance of iridium capsules containing inactive ceramic cobalt compounds through 2500 h in argon at 1600°C was related to concentration of tungsten impurity in iridium. Platinum capsules containing inactive ceramic cobalt compounds swelled from creep of the platinum during 125-h tests in argon at 1200°C. The heat of Nickel 201 used to fabricate the core of the WANL Demonstration Unit exhibited satisfactory oxidation resistance through 10,000 h at 1000°C and through 3000 h at 1125°C. The demonstration test of the ^{60}Co-fueled thermoelectric generator

was terminated after 27 months of satisfactory operation; electrical output had decreased from 80.1 to 36.5 w. (auth)

21447 (MLM-1629) COMPILATION OF SOME RADIATION PROPERTIES OF VARIOUS PLUTONIUM-238 AND POLONIUM-210 HEAT SOURCES. Neff, R. A. (Mound Lab., Miamisburg, Ohio). 16 May 1969. Contract AT(33-1)-Gen-53. 138p. Dep. NTIS $9.00.

Declassified 31 October 1972.

A compilation of literature data collected to date on the radiation characteristics of various types of plutonium-238 and polonium-210 heat sources is presented. These data include total neutron emission values, gamma and neutron dose rates, spectra, and flux distribution for these sources which were fabricated at Mound Laboratory. (auth)

21448 (ORNL-4910) CURIUM DATA SHEETS. Butler, T. A.; Ketchen, E. E.; DiStefano, J. R. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 46p. Dep. NTIS $5.45.

Data sheets are provided for ^{244}Cm products recovered from the processing of spent fuels from power reactors. These products include $^{244}Cm_2O_3$, ^{244}Cm metal, $^{244}Cm_2O_2S$, and $^{244}CmF_3$. The data include: composition; specific power and power density; radiation; critical mass; compatibility; thermophysical properties; mechanical properties; chemical properties; biological tolerances; and shielding data. (LCL)

21449 THULIUM OXIDE HEAT SOURCE AND METHOD FOR HEATING SAME. Allen, C. H.; Leach, C. E. (to United States Atomic Energy Commission). Australian Patent 431,075. 6 Dec 1972. Priority date 9 Aug 1968, United States of America (USA).

A heating device is described which comprises a housing having solid upper and lower heads connected by a hollow body. The lower head has a plurality of manifolds and coolant tubes in the body; the coolant tubes mating at both ends with the manifolds. A portion of each coolant tube is perpendicular to the upper and lower heads and a portion of each coolant tube is parallel to the upper and lower heads. A method is provided for introducing a coolant into the coolant tubes, a plurality of fuel tubes being spaced from and arranged in clusters about each of the coolant tubes, with fuel tubes being perpendicular to the upper and lower heads and parallel to a portion of the coolant tubes. The fuel elements contain an elongated radioactive thulium oxide rod greater than 0.04 in. in dia housed within the fuel tubes and removable therefrom; a heat-exchange medium filling the space between the coolant tubes and the fuel tubes; and a backup cooling system separate from the coolant tubes for introducing coolant into the body at a predetermined time. (auth)

21450 NUCLEAR ENERGY SOURCES FOR IMPLANTABLE CARDIAC PACEMAKERS. Schaldach, M. (Univ., Erlangen Nuernberg, Ger.). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

The serviceable lifetime of implanted cardiac pacing systems could be extended so as to achieve operating times of up to three years, with a practically unlimited operating time of the electrode. Work is under way to develop new energy sources that will eliminate the disadvantage of limited capacity of the batteries presently in use and it is hoped that the application of new stimulating electrodes will reduce the amount of energy required for the stimulation of heart muscle contraction, thus reducing the current consumption. Decisive improvements are expected to be brought about by the development of isotope batteries and electrochemical procedures (such as bioelectrical energy generation in fuel cells) and non-polarizable stimulating electrodes. (GE)

Radiation Sources

Refer also to abstracts 21014 and 23011.

21451 (BNWL-1308-14) PACIFIC NORTHWEST LABORATORY, ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT: FEBRUARY–APRIL 1973. Jarrett, J. H. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. 30p. Dep. NTIS $4.00.

Progress is reported on the following programs: compatibility testing of $^{90}SrF_2$ heat sources with capsule materials; development of ^{13}N generator for medical uses; development of $^{90}Sr-^{90}Y$ blood irradiator; dosimetry studies of radioisotope-powered circulator support system; development of americium alpha source; nuclear techniques for seabed mineral exploration; and pressure testing (1000 bar) of $^{90}SrF_2$ capsule. (TFD)

21452 RADIATSIONNAYA TEKHNIKA. Vypusk 7. (Radiation Techniques. Issue 7). Shtan, A. S. (ed.). Moscow; Atomizdat (1972). 248p.

Theoretical articles on different questions of radiation techniques are presented, e.g., optimization of the process of irradiation during the production of isotopes; analysis of the attenuation curve of the current of α emissions in gases; analytical determination of losses; calculation of the shield for the linear accelerator LEU-8/5; etc. A series of articles were devoted to radioisotope thermoelectric generators, irradiation installations, and different radioisotope devices. In particular information possibilities of the devices were examined. Significant space was allotted to the investigation of apparatus and method of measurement of activation and x-radiometric analyses of materials as well as to investigations by means of automatic installations. Specific possibilities of radiographic control were examined. The small-dimension gamma defectoscopes Stapel-5 and RID-11 were examined. The stability and economic efficiency of the introduction of some developments were investigated. (tr-auth)

21453 RADIATSIONNAYA TEKHNIKA. Vypusk 8. (Radiation Techniques. Issue 8). Shtan, A. S. (ed.). Moscow; Atomizdat (1972). 255p.

Results are reported of theoretical and experimental investigations on the nuclear physical bases of radiation techniques, control of the efficiency and prediction of the gradual breakdown of radioisotope relay devices, neutron radiographs, systems of activation analysis, methods and apparatus of x-radiometric analysis, radiation sources, and apparatus for radiation therapy. Materials were presented on construction and investigation of nuclear (atomic) batteries and heat pipes. Some articles were devoted to devices and apparatus developed in institutes: radioisotope level gages and densimeters, systems for laboratory activation analysis, and equipment for the determination of tantalum and niobium. (tr-auth)

Design and Fabrication

21454 (DP-MS-72-4) PALLADIUM–^{252}Cf OXIDE CERMET, AN IMPROVED FORM FOR ^{252}Cf NEUTRON SOURCES. Mosley, W. C.; Smith, P. K.; McBeath, P. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT (07-2)-1. 41p. (CONF-720607-36). Dep. NTIS $4.25.

From 10th annual American Nuclear Society conference; Las Vegas, Nevada, USA (18 Jun 1972).

Palladium metal wire, containing a uniform dispersion of up to 2.5 vol % of ^{252}Cf as mixed oxides, has been developed as an improved neutron source material of ^{252}Cf. The production process includes admixing by chemical plating of ^{252}Cf oxide with palladium, powder metallurgical consolidation and forming by sintering cermet powder into billets, and fabrication into bare or sheathed wire by rolling, swaging, and drawing. Wires 0.040-inch in diameter and containing 1 to 1000 μg of ^{252}Cf/inch can be made; these wires can also be roll clad to adjust the concentrations of stock wires, if required. Incorporation of 80 to 90% of invested ^{252}Cf into the final product has been demonstrated with control of the Cf/Pd ratio to ±5%. ^{252}Cf content and linear ^{252}Cf uniformity in wires are measured by neutron counting and densitometer analysis of autoradiographs. Mechanical properties of cermet wire have been determined using palladium–Sm_2O_3 cermet as stand-in for ^{252}Cf. Radiation embrittlement up to 0.5 GVR was shown not to be significant on both ^{252}Cf- and ^{242}Cm-loaded wires. (auth)

21455 (DP-MS-72-41) ^{252}Cf ENCAPSULATION AND SHIPPING AT SRL. Boulogne, A. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1972. Contract AT(07-2)-1. 15p. (CONF-720902-7). Dep. NTIS $3.00.

From national topical meeting on the application of californium-252; Austin, Texas, USA (11 Sep 1972).

Techniques were developed at the Savannah River Laboratory to encapsulate ^{252}Cf sources for research and for medical and industrial applications. The sources are for sale or loan under the USAEC market evaluation program. A new facility is described which limits radiation exposure rates to <1 mrem/h in normally occupied areas, except for short periods when maximum amounts of up to 100 mg of ^{252}Cf may be handled. Sources as large as 10 mg have been made in this facility. The entire complex is surrounded by up to 48 in. of gamma and neutron shielding. Equipment was designed for remote handling, assembly, and examination of microliter quantities of solutions and capsule components as small as $\frac{1}{8}$-in. cylinders. Special equipment, procedures, and carriers are described for safe, practical handling, storage, and shipment of encapsulated ^{252}Cf. Brief descriptions and photographs of six casks most commonly used for transporting quantities ranging from 100 μg to 50 mg of ^{252}Cf are included. (auth)

21456 PREPARATION OF A HIGH–ACTIVITY ^{58}Co SOURCE. Sherief, M. K.; Grass, F. (Oesterreichische Hochschule, Vienna). Atomkernenergie; 21: No. 2, 139-140(1973).

A method for the separation of Ci-amounts of ^{58}Co from irradiated nickel by ion exchange resins is described. A method

for the preparation of a highly radioactive ^{58}Co source by electrodeposition is described. The properties of these sources offer many advantages, including their extremely small size, uniformity of shape and composition, and easy handling. (GE)

21457 QUALITY OF THIN ELECTROLYTIC LAYERS OF IRON. Danilin, L. D.; Rachev, V. V.; Pavlova-Verevkina, A. I. Sov. Radiochem. (Engl. Transl.); 14: No. 6, 956-957(1972).

Translated from Radiokhimiya; 14: No. 6, 915(1972).

An investigation of the conditions for producing high-quality thin layers of iron was conducted in order to evaluate the electrolytic method for preparing x-ray sources of ^{55}Fe. It was concluded that to obtain uniform deposits at a concentration of Fe^{2+} of 10 g/liter it is desirable to use ammonium sulfate, and the current density should not exceed 10 mA/cm^2 at pH = 2.2 to 2.4. When the pH is raised, the current density can be increased without detriment to the quality of the deposits.

21458 FAIL-SAFE HIGH-ENERGY RADIATION SHUTTERING APPARATUS. Thomas, R. L. Jr. (to Charles Supper Co., Inc.). U. S. Patent 3,721,826. 20 Mar 1973. Filed date 5 Aug 1970. 10p.

A shuttering apparatus for controlling and signaling of the passage of high-energy radiation is described. It includes a shutter containing a normally closed gate which is opened by energizing a solenoid actuator through a control circuit. The control circuit includes a novel interlock which prevents energization of the solenoid except when a beam-receiving means (a beam tunnel, for example) is properly interfaced with the shutter. An inerrant mechanical flag indicator is off-set from the gate and baffled in a novel manner to preclude escape of scattered radiation. The apparatus includes other safety features for maximizing user protection against accidental or inadvertent exposure to radiation. (Official Gazette)

21459 DYNAMIC INVESTIGATION OF PULVERIZED COAL MILL BY ISOTOPE MEASURING METHODS. Petz, E.; Czinder, J. Energ. Atomtech.; 25: No. 10, 456-466(Oct 1972). (In Hungarian).

The radioactive tracer technique can be used advantageously to determine the pulverized coal concentration leaving a pulverized coal mill. The basic theory of this measuring method is summarized. Results of measuring experiments are described. The measuring method is equally applicable to determine both the distribution of the pulverized coal concentration and to draw the transitional functions. (auth)

Industrial Uses

Refer also to abstracts 20760, 21119, 21143, 21379, 21495, 21535, 21577, 21586, 21587, 21592, 21593, 21612, and 21626.

21460 (CONF-721091-) NATIONAL CONFERENCE ON THE TECHNOLOGICAL APPLICATIONS OF NUCLEAR TECHNIQUES, 1972, PELINDABA, SOUTH AFRICA, OCTOBER 12–13, 1972. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 1972. 242p. (In English and Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Separate abstracts were prepared for the 35 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 20669–20671, 20760, 20877, 20878, 20972, 21002, 21117–21127, 21366, 21367, 21400, 21461–21470, 21535, 21629, and 21836.

21461 (CONF-721091-, pp P1-P9) NEW NUCLEAR TECHNIQUES. Snyman, G. C. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Recent advances in radioisotope technology are characterized by the large number of element-analysis techniques that were reported. The absorption of low-energy gamma rays and x rays was successfully employed to measure single-element concentrations in solutions and slurries. Multiple elements, such as ash content of coal, were measured with absorption and scattering techniques. Beta and gamma-absorption methods were used for particle-size analysis in the mineral industry. The radioisotope x-ray fluorescence analysis technique has been developed and applied to the analyses of a large variety of elements in matrices such as alloys, ores, solutions and slurries. The availability of solid state detectors for resolving the energy spectrum of x-rays and gamma rays is a major breakthrough of this decade. Production of the neutron-emitting transuranium isotope ^{252}Cf has opened the way to a more general use of neutron techniques. Californium-252 has been used for on-line and in situ neutron activation analysis to evaluate mineral deposits and to analyze samples. A portable neutron-radiography camera was made and demonstrated. The use of ^{252}Cf and solid state detectors broadens the potential of prompt gamma-analysis techniques for lighter elements. The use of gaseous sources for nuclear resonance fluorescence has brought this technique a step nearer to being suitable for industrial applications. Reliable isotopic power sources suitable for use with human-heart pacemakers and artificial hearts are being developed in Europe and the USA. Radioisotopic heat and electricity generators have been used successfully in experiments involving spacecraft and the moon. It is concluded that radioisotope techniques will play an important role in future industrial development and in particular in the mining and metallurgical industries. South African industries should continue to benefit from radioisotope techniques and could even become a source of new ideas in radioisotope technology. (auth)

21462 (CONF-721091-, pp P3.p1-P3.p6) RECENT DEVELOPMENT IN INDUSTRIAL RADIATION PROCESSING. Basson, R. A.; Jurriaanse, A.; Van der Linde, H. J. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Developments in the applications of radiation in industry, overseas and in South Africa are reviewed. Particular attention is paid to the use of irradiation in the modification of plastics (such as in the cross-linking of polythene), in the production of graft co-polymers (used in many fields including permanent press textiles) and in the curing of coatings. The production of composite materials such as wood-plastics is also discussed with special reference to improved properties and applications. A typical example of a radiation initiated chemical synthesis is given and the prospects for the industrial application of this type of process are examined. Finally, a brief introduction to the use of radiation in medical products sterilization and food preservation is given. (auth)

21463 (CONF-721091-, pp P8.p1-P8.p3) USE OF RADIOISOTOPES BY THE ELECTRICITY SUPPLY COMMISSION. Dutkiewicz, R. K. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The use of radioisotopes by ESCOM is growing, the main field of activity being in research where results are being obtained in areas where, quite often, no other techniques are possible. The use of radioisotope techniques requires adequately trained staff, or the services of an organization such as the Isotopes and Radiation Division of the Atomic Energy Board. Care has to be taken in the selection of equipment for radioisotope work and it has been found that many local suppliers of equipment do not have the necessary expert knowledge to provide adequate installation supervision or servicing. (auth)

21464 (CONF-721091-, pp P9.p1-P9.p14) USE OF RADIOISOTOPES IN INVESTIGATING THE FLOW PATTERNS IN AN INDUSTRIAL ABSORPTION TOWER. Woodburn, E. T. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Work on the use of ^{85}Kr to describe the mixing in the gas phase of an absorption tower in which carbon dioxide is being absorbed by counterflowing water, is discussed. The tower is 0.29 m in internal diameter and has a packed depth of 10.97 m. It is packed with 0.025 m stoneware raschig rings, and results are available over the range of liquid Reynolds Numbers from 0 to 1500 for a gas flow equivalent to a Reynolds Number of 73.5. The experimental information is further reported in which the axial mixing coefficient was inferred from the steady state absorption profile in the column in terms of an inlet discontinuity. The mixing coefficients recorded in the two methods are consistent within the experimental error of the apparatus. A limiting value for the gas phase Peclet Number when the liquid Reynolds Number exceeded 700 was reported and it was shown that this was consistent with the onset of recirculations in the gas phase. A simple network model has been suggested which incorporates variations in gas pore velocity to account for the increase in gas phase dispersion at liquid Reynolds Number between 0 and 700. (auth)

21465 (CONF-721091-, pp P12.p1-P12.p6) EXPERIENCE IN THE APPLICATION AND USE OF RADIOACTIVE MATERIAL AT SOUTH AFRICAN PULP AND PAPER INDUSTRIES LIMITED. Classens, J. A. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Application of radioisotopes has proved to be of great assistance in the paper industry. Used in conjunction with other measurements, particularly of moisture, it is possible to produce paper and boards within very close limits. Not only does it find application in automatic control but it also obviates the use of continuous laboratory checks to ensure that the product specifications are met. Other applications allow for the continuous control of pro-

cesses which would not otherwise be possible. Control of levels of the contents of closed vessels on some processes would not be possible without the use of radioactive material. Other possible applications include the use of irradiation techniques which can perhaps improve the yields of our natural resources. Other investigations might lead to improved control or quality of effluent. (auth)

21466 (CONF-721091-, pp P20.p1-P20.p5) LIQUID AND SOLIDS FLOW PATHS IN CONTINUOUS THICKENERS. Scott, K. J.; Paulsen, J. P. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Irradiated particles of various sizes were added to the feed stream of a full-scale continuous thickener and their passage followed by means of Geiger counters, while the liquid flow was observed by radioactive tracers or dyes. Incoming feed slurry plunges immediately to its own density level, spreads out radially and deposits its entire load of solids on top of the mud zone. After consolidating fairly rapidly to a specific gravity of 1.4, particles of all sizes descend at rates governed mainly by the volumetric underflow discharge rate. Circulating currents observed in models evidently occur in larger tanks but velocities are much reduced and may be neglected in correcting for batch settling velocities measured under quiescent conditions. Altering the position of feed, overflow and underflow points, addition of baffles or redesign of rakes does not appear to be warranted. (auth)

21467 (CONF-721091-, pp P21.p1-P21.p4) STUDY OF MINERAL ORES IN GRINDING CIRCUITS WITH RADIOTRACERS. Exall, D. I. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

A technique is described for radioactive marking of mineral ores in order to follow its behavior in a grinding mill. The occurrence of the tracer materials in the ores is examined and an actual test on a large industrial pebble mill is briefly described. The results show that the method is feasible although the interpretation in terms of the conventional rate and breakage functions needs further examination. (auth)

21468 (CONF-721091-, pp R2.b1-R2.b6) TECHNOLOGICAL APPLICATION OF NUCLEAR TECHNIQUES IN SOUTH AFRICA: A CRITICAL REVIEW. Basson, J. K. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Previous technical reviews have concluded that South African industry has progressed satisfactorily with the application of radioisotopes and radiation by well-established techniques such as gaging and radiography. Other nuclear techniques such as leak detection, flow measurement and, in particular, radioisotope-excited x-ray fluorimetry have since received increasing attention—even some initial results with neutron radiography are available. Tracer techniques have also been firmly promoted, due to the wide range of facilities which have been built-up around the high flux ($>10^{14}$ n cm^{-2} sec^{-1}) SAFARI I research reactor at the National Nuclear Research Center, Pelindaba. Neutron activation analysis has also been developed, with a wide range of facilities for exploitation on a routine basis. A technological facility for massive irradiation was inaugurated during August 1971 for medical, food, and chemical processing. Generally speaking, it can be stated that the facilities for the full technological utilization of nuclear techniques in South Africa are well-established, including the supply of the full range of radionuclides and associated apparatus. The fact that there are 264 authorized nonmedical users (end of 1971) consuming more than 3000 annual consignments of isotopes gives some, though by no means a complete, indication of the measure of isotope utilization. A critical review is given of the extent to which these sophisticated modern physical techniques are being put to use. It is concluded that, although a sound balance has been maintained, the rightful extension of nuclear techniques is determined mainly by the increasing sophistication of technology in South Africa. (auth)

21469 (CONF-721091-, pp R16.b1-R16.b6) FACILITIES AT PELINDABA FOR SERVICE IRRADIATIONS AND DEVELOPMENT STUDIES. Du Plessis, T. A.; Tanewski, E. Z.; Entwistle, B.; Venter, D. J. E. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

A brief survey is given of the various irradiation facilities available at Pelindaba for applied research and service irradiations. Some of the problems that were encountered with these facilities and the changes introduced to remedy them are discussed. Special attention is given to the package irradiation plant which is used on a routine basis for service irradiations and which can be used for the irradiation of a variety of medical and pharmaceutical products. The pool facility which is used for the limited production of wood plastics and for pilot plant studies of chemical processes, and which was designed and manufactured entirely at Pelindaba, is also discussed. (auth)

21470 (CONF-721091-, pp R30.b1-R30.b2) EFFECT OF SCATTERING WITHIN A KILOCURIE ^{60}Co SOURCE ON THE INTENSITY OF THE EMITTED PHOTONS OF 1.17 and 1.33 MEV. Visser, C. J.; Mouton, W. L. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The 5,000 Ci ^{60}Co source of the Fruit and Fruit Technology Research Institute is used mainly for the irradiation of agricultural materials. The source is cylindrical in shape (with a height of 44 mm and a 28 mm diameter) and is encapsulated in a stainless steel cup. Due to interactions of the primary radiation with the source material itself and the surrounding encapsulation, the energy spectrum will consist of two peaks, superimposed on a continuous background. Direct measurements of the spectrum could not be carried out due to the high intensity of the emitted radiation and the relatively small dimensions of the irradiation chamber in which the source is housed. The intensity of the 1.17 and 1.33-MeV photons emitted by the source was determined by observing elastic scattering of these photons from light elements. Scatters of arsenic, copper, zinc, cobalt, phosphorus and aluminium were consecutively placed in the direct ^{60}Co beam and the elastically scattered radiation detected by means of a Ge(Li) γ-spectrometer. Calculations were performed by computer and the results obtained with different scatterers compared favorably. Average values for all the scatterers provided values of $(0.94 \pm 0.13) \times 10^{14}$ and $(1.01 \pm 0.12) \times 10^{14}$ photons per second, of energy 1.17 and 1.33 MeV, respectively. This constitutes 62% of the total curie content as specified by the manufacturers. The remaining 38% was mainly converted to energy-degraded photons. Uncertainties in the results are mainly due to counting statistics and accuracy of the efficiency calibration. This method provides a simple and, according to the results, a fairly accurate means for the determination of the intensity of the primary photons emitted by strong radioactive sources. (auth)

21471 (DP-MS-72-33) ANTICIPATED MARKET FOR SYSTEMS USING CALIFORNIUM-252. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1972. 22p. (CONF-720592-1). Dep. NTIS $3.25.

From californium-252 utilization meeting; Chicago, Illinois, USA (24 May 1972).

An estimate of the business activity associated with devices containing ^{252}Cf during the years 1972 to 1980 is presented. The estimates are based on a survey of approximately 100 industrial, educational, and governmental organizations interviewed in the period April to December 1971. The survey was made to assist the U. S. Atomic Energy Commission in planning future requirements for this radionuclide. It should be remembered that this survey represents a consensus of informed opinion and should be understood and used as such. (auth)

21472 (EURISOTOP-58) INHIBITION OF SPROUTING IN POTATOES BY IRRADIATION IN THE NETHERLANDS: ECONOMIC AND COMMERICAL ASPECTS. Sparenberg, H.; Ulmann, R. (European Communities, Brussels (Belgium). Commission). May 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

The technical and economic aspects of the method of irradiation, and the manner in which the irradiated potatoes are marketed are given. (TFD)

21473 (STI/PUB-327) SOIL-MOISTURE AND IRRIGATION STUDIES. II. Panel Proceedings Series. Proceedings of a Panel Held at Vienna, Austria, November 2–6, 1970. (International Atomic Energy Agency, Vienna (Austria)). Apr 1973. 194p. (In Several Languages). (CONF-701156-). IAEA $7.50.

A separate abstract was prepared for 9 of the 12 papers presented at the conference. The 3 remaining papers were not in the subject scope of NSA. (TFD)

For abstracts of individual papers see: 21142, 21143, 21372–21376, 21379, and 21478.

21474 (TT-70-55107) RADIOISOTOPES IN INDUSTRY. Second National Symposium on Technical Applications of Radioisotopes, Spala, Poland, 1963. 1973. Translation of Collective Reports from II Krajowe Sympozjum Zastosowan Izotopow Promieniotworczych w Technice, Spala, 1963. 322p. NTIS $18.25.

Ninety four papers from Poland and ten from abroad were submitted. In order to make the presentation of all the papers possible in the time provided, the Polish papers were sent to eleven specialists in different areas of isotope applications for review. The collective reports written by these specialists are

presented. The papers by foreign guests are presented in an abridged form. (TFD)

21475 RADIOCHEMICAL PROCESSES FOR PROMOTION OF PROCESS TECHNIQUES IN THE TEXTILE INDUSTRY. van Lancker, M. (Centre Scientifique et Technique de l'Industrie Textile Belge, Brussels). Textilis; 28: No. 7-8, 12-21(1972). (In Dutch).

In connection with the possibilities for the application of ionizing radiations in the textile industry, it is concluded that: (1) the beta rays produced by electron accelerators should actually be preferred to gamma sources, e.g., ^{60}Co and (2) the cost of an electron accelerator cannot constitute an obstacle to the later industrial development. The use of synthetic resins is again a predominant factor in increasing costs. A minimal use of monomers should be a major object. (tr-INIS)

21476 RADIOISOTOPE EVALUATION OF METAL CLEANING PROCESSES. Voss, T. E.; Korpi, G. K. Metal Finish.; 70: No. 2, 76(1972).

Radiotracer techniques are nondestructive and provide a simple means for conducting repetitive studies of metal cleaning and measurements. (Corrosion Abstr.)

21477 MEASUREMENT OF LOCAL MATERIAL TRANSITION BY RADIOISOTOPES ON BODIES SURROUNDED BY CIRCULATING GAS. Glietenberg, H. Stuttgart; Univ. Stuttgart (1972). 130p. (In German).

Thesis.

A method for measuring local mass transfer numbers at bodies around which air is forced to circulate, is described. Initially, a radioactive labeled reaction gas (sulfur dioxide with ^{35}S) is applied which is added to the streaming air in a closed wind tunnel in small amounts. A sample body (circular cylinder of 50 mm dia subject to lateral flow) is covered with a chromatography paper soaked in the reaction solution, and is reacted with gas in the wind tunnel. On the paper's surface the reaction gas is absorbed in the solution and is chemically bound. The radioactive covering of ^{35}S, resulting from the attack with gas on certain parts of the paper, is measured by a proportional counting tube and over the photometric evaluation of the autoradiographic foils. The concentration of ^{35}S during the attack with gas in the wind tunnel is measured by means of gas samples by a liquid-scintillation counting technique. The mass transfer numbers could be given with a very good local resolution and with a mean quadratic error of ±5%, taking the autoradiographic evaluation as a basis. Besides the local mass transfer numbers, the mean numbers of the arbitrary chosen surface sections can also be simultaneously determined both quickly and accurately. (GE)

21478 IMPLICATIONS TO AGRICULTURE IN DEVELOPING COUNTRIES OF USE OF NUCLEAR TECHNIQUES IN SOIL PHYSICS AND IRRIGATION STUDIES. Stout, P. R. (Univ. of California, Davis). pp 3-13 of Soil-Moisture and Irrigation Studies. II. Vienna; International Atomic Energy Agency (1973).

From panel on the use of nuclear techniques in soil physics and irrigation studies II; Vienna, Austria (2 Nov 1970). See STI/PUB-327; CONF-701156-.

FAO/IAEA projects using radioactive nuclides in water-use efficiency studies have contributed materially to the "Green Revolution." Knowledge of water-use efficiency is particularly crucial to planning in working on problems of nuclear powered desalting of sea water for agricultural purposes. Energy is playing an increasingly important role in improving agricultural efficiency, not only in agricultural operations but in producing fertilizer materials crucial to high agricultural production. Nuclear power appears to be the primary future source of energy to supply increasingly important needs of agricultural production and to sustain the "Green Revolution." (auth)

21479 RADIOISOTOPE STUDIES ON THE PISTON RING AND SLOT WEAR OF A SIX-CYLINDER DIESEL ENGINE. Kaiser, W. (Kernforschungszentrum, Karlsruhe, Ger.). Motortech. Z.; 34: No. 4, 127-128(1973). (In German).

The wear properties of different piston ring and slot types and different slot materials have been tested in an air-cooled Diesel engine by means of radioisotopes. Due to the activation of the test parts by means of reactor neutrons and deuterons and α-particles from a cyclotron, up to three wear components without change of one test part have been simultaneously determined for the first time. The wear of the lower and upper ring and slot edges has been separately measured. In addition to the influence of the oil temperature, the influence of the rate of revolution and of the load on the wear have been studied. (GE)

21480 GAMMA IRRADIATION OF TOMATOES. Preliminary Tests on the Supermarmande Variety. Baraldi, D.; Belli-Donini, M. L.; Guerrieri, G.; Inghilesi, F.; Magaudda, G. (Centro Studi Nucleari, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 80-85(May 1973). (In Italian).

Tomatoes of the Supermarmande variety were exposed to ^{60}Co irradiation at doses of 100, 200, 250, and 300 krad at room temperature. Physical, chemical, biochemical, and microbiological examinations were made of the fruit stored at room temperature and at 25°C for 21 days. The results are graphed and tabulated. They show that irradiation has not shown significant advantages with respect to prolonging the storage life of tomatoes. (JSR)

21481 SCIENTIFIC AND TECHNICAL ASPECTS OF THE INDUSTRIAL APPLICATION OF RADIOISOTOPES. Salvetti, C. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 37-45(May 1973). (In Italian).

The applications of nuclear radiations for industrial purposes embrace all sectors of industry and can be divided in a number of classes, depending on the type of use made of the radiations emitted. The analysis, measurement, and control techniques based on the use of radioisotopes constitute a factor of progress in industry, for the study and development of processes and materials and for process control and automation applications. Their applications are reviewed and some considerations on the cost of the equipment, as well as on personnel savings and waste reduction made possible by the use of nuclear techniques, are discussed. (auth)

21482 FRENCH LEGISLATION CONCERNING IRRADIATED AGRICULTURAL PRODUCTS. Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 86-88(May 1973). (In Italian).

Legislation controlling the marketing of irradiated potatoes and the dose limits for the irradiation of potatoes is presented in its entirety. (JSR)

21483 SEWAGE SLUDGE PROCESSING BY PASTEURIZATION OR IRRADIATION. Obrist, W. (Eidgenoessische Anstalt fuer Wasserversorgung, Abwassereinigung und Gewaesserschutz, Duebendorf, Switzerland). Staedtehygiene; 23: No. 3, 68-70 (1972). (In German).

To eliminate health hazards through the agricultural utilization of sewage sludge, methods of disinfection were developed, i.e., pasteurization or irradiation. Advantages and disadvantages have to be evaluated and costs calculated. (GE)

21484 COMPARATIVE EFFECTS OF ETHYLENE OXIDE, GAMMA IRRADIATION, AND MICROWAVE TREATMENTS ON SELECTED SPICES. Vajdi, M.; Pereira, R. R. (Univ. of Manitoba, Winnipeg). J. Food Sci.; 38: No. 5, 893-895(1973).

Microbiological, chemical, and physical effects of gamma irradiation, ethylene oxide and microwaves on six ground spices (black pepper, paprika, oregano, allspice, celery seeds, and garlic) and their effects on the quality of garlic sausage containing such spices were studied. In general, gamma irradiation was most effective for the destruction of bacterial flora in spices. Ethylene oxide treatment affected oil content of the spices and color of paprika, while gamma irradiated spices indicated no change following radiation. With respect to garlic sausage, microbiological examinations indicated the highest increase in sausages made with untreated spices followed by the ethylene oxide treated and gamma irradiated spices during the storage at different conditions of incubation. Flavor analysis indicated no significant difference among the sausages. However, preference analysis indicated that the panel preferred sausages made with the gamma irradiated spices to ethylene oxide treated samples. (auth)

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21485 SHORT REVIEW OF SOME ACTUAL PROBLEMS OF THE MOLECULAR RADIOBIOLOGY. J. Nagy, E. Magy. Radiol.; 25: No. 3, 176-185(1973). (In Hungarian).

The development of molecular radiobiology as an independent discipline is briefly reviewed and the biochemical characteristics of the radioreactions of the nuclei acids, cleared up for the most part in the last 20 years, as well as the conditions of the reparation of the radiation injuries are discussed. (auth)

21486 ABSTRACTS OF PAPERS PRESENTED AT THE 4TH ANNUAL MEETING OF THE EGYPTIAN SOCIETY OF GENETICS, ALEXANDRIA, EGYPT, MARCH 14-15 1973. Egypt. J. Genet. Cytol.; 2: No. 2, 370-378(Jul 1973).

From 4th annual meeting of the Egyptian Society of Genetics; Alexandria, Egypt (14 Mar 1973).

Radiation Effects on Biochemicals

Refer also to abstracts 20796, 20802, 21570, 21581, and 21717.

21487 (ORO-3631-4) RADIATION BIOPHYSICAL STUDY OF BIOLOGICAL MOLECULES. Progress report, February 1, 1972-July 31, 1973. Fluke, D. J. (Duke Univ., Durham, N. C.). 1973. Contract AT(40-1)-3631. 4p. Dep. NTIS $3.00.

Results are reported from a study on the effects of temperature on radiation damage and repair of dry bacteriophage following exposure to uv radiation or electrons. Preliminary results are reported from a study on the effects of oxygen on the activity of superoxide dismutase in solutions following exposure to electrons. (CH)

21488 (SU-326-P-7-X-25) REPAIR OF DAMAGED DNA IN VIVO. Annual Progress Report, June 1, 1972-June 1, 1973. Hanawalt, P. C. (Stanford Univ., Calif. Herrin Labs.). Jun 1973. Contract AT(04-3)-326. 8p. Dep. NTIS $3.00.

Progress is reported on the following research projects: effects of toluene on uv-stimulated DNA synthesis in Escherichia coli mutants deficient in DNA polymerase; development of a chromatographic technique for the separation of ^{32}P-labeled pyrimidine nucleotide dimers from ^{32}P-phosphate in enzymatic hydrolysates of uv-irradiated DNA; repair of DNA in HeLa cells after uv irradiation; thymineless death in Escherichia coli; isolation of thymine-requiring mutants of Micrococcus radiodurans; high-temperature death in DNA β mutants; isolation and characterization of a thymineless death resistant mutant; mechanism of action of phleomycin; turnover of 5-bromouracil-containing DNA in E. coli; DNA turnover in normally growing cells; integrity of DNA in thymine-starved E. coli; and the effect of thymine dimers on DNA:DNA hybridization. (HLW)

21489 STRUCTURE AND FUNCTION OF IRRADIATED DNA. Hagen, U. (Kernforschungszentrum, Karlsruhe, Ger.). Biophysik; 9: No. 4, 279-289(1973). (In German).

The effects of ionizing radiation on the physico-chemical structure of DNA and on its biological function are surveyed. The formation of single strand breaks and double strand breaks is described as they arise under various conditions of irradiation, i.e., in dilute aqueous solution, in the dry state, or in the irradiated cell. Much less is known about the damage to the structure of nucleotide bases. The biological function of DNA can be tested in vitro by its template activity in the enzymatic RNA synthesis with RNA polymerase. Whereas the radioinduced single strand break may preponderantly be responsible for stopping the transcription along the DNA molecule, the base damages may partly lead to insertion of a wrong base into the RNA in the course of transcription. The enzymatic reactions leading to the repair of the radiation damage in the DNA of irradiated cells are considered. The joining of single strand breaks and the substitution of damaged DNA sections by repair replication are described. (auth)

21490 CHANGES IN THE INFRARED SPECTRA OF DNA AND DNP ON EXPOSURE TO IONIZING AND ULTRAVIOLET RADIATION. Zhizhina, G. P.; Bobovich, S. I.; Kruglyakova, K. E. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 5, 1142-1145(11 Apr 1973). (In Russian).

Damage to the primary and secondary structure of DNA and DNP caused by in vitro irradiation by γ (source not specified) and uv was studied by ir spectroscopy. Reduced ir absorption in the bands at 3350, 3200, and 1605 cm^{-1} was noted after 55 krad of γ exposure. Bands at 1705, 1090, and 1060 were altered, shifted, or disappeared after exposure of DNA to 4.6×10^6 ergs/mm^2 of uv radiation (260 mμ). (KSW)

21491 METABOLISM OF HISTONE FRACTIONS. V. Relationship Between Histone and DNA Synthesis After X-Irradiation. Gurley, L. R.; Walters, R. A. (Los Alamos Scientific Lab., NM). Arch. Biochem. Biophys.; 153: 304-311(Nov 1972).

The observation that x irradiation inhibits ^{3}H thymidine incorporation into DNA is commonly interpreted to indicate that DNA synthesis is inhibited by x irradiation. Although ^{3}H thymidine incorporation into DNA is inhibited in cultured Chinese hamster cells by 800 rads of x irradiation, DNA replication rate remains unaffected by radiation treatment when DNA replication rate is measured by a mass assay. The synthesis of the five histone fractions [f1, f2b, f2a1, f2a2, and f3] was also unaffected by 800 rads of x irradiation; therefore it was concluded that the treatment of cells with enough x irradiation to inhibit cell division for 8 hr and eventually to cause death of 95% of the irradiated cell's progeny does not disrupt coordination between histone synthesis and DNA replication during x-ray-induced division delay. Division delay in the presence of normal DNA and histone synthesis rates results in the accumulation of cells in a G_2-like cell-cycle state after irradiation. Although histone f3 biosynthesis was found to be unaffected by x irradiation, preformed protein (either histone f3 or some nonhistone contaminant) was observed to accumulate in excess of f3 preparations during x-ray-induced division delay. Using preparative electrophoresis to purify these preparations, it was demonstrated that histone f3 did indeed accumulate in excess in chromatin after irradiation and that this f3 was synthesized at least 10 hr prior to its isolation and existed in some non-chromatin pool at time of irradiation. Some scavenging of amino acids for the synthesis of histones was detected during the x-ray-induced division delay period, but experiments showed that this did not account for all excess preformed f3 accumulated on the chromatin. (auth)

21492 AFFINITY LABELING OF E. COLI RNA POLYMERASE WITH SUBSTRATE AND TEMPLATE ANALOGUES. Frischauf, A. M.; Scheit, K. H. (Max-Planck-Institut fuer Biophysikalische Chemie, Goettingen, Ger.). Biochem. Biophys. Res. Commun.; 53: No. 4, 1227-1233(21 Aug 1973).

Irradiation of Escherichia coli RNA polymerase at 330 to 360 nm in the presence of either 4-thiouridine triphosphate or polydeoxy-4-thiothymidylic acid leads to covalent substitution by substrate or template analogue and causes irreversible inactivation of the enzyme. Evidence for specific inactivation was obtained from kinetic experiments. The sites of chemical modification of RNA polymerase were shown to be exclusively the subunits β' and β. (auth)

21493 COMPARISON OF THE EFFECT OF ULTRAVIOLET RADIATION AND ETHIDIUM BROMIDE INTERCALATION ON THE CONFORMATION OF SUPERHELICAL ϕX174 REPLICATIVE FORM DNA. Denhardt, D. T.; Kato, A. C. (McGill Univ., Montreal). J. Mol. Biol.; 77: No. 4, 479-494(15 Jul 1973).

Irradiation of superhelical bacteriophage ϕX174 replicative form DNA with uv light increased the sedimentation coefficient of the DNA in 1 m-NaCl. Evidence that this is caused by the formation of pyrimidine dimers is provided by the observation that treatment of the DNA with photoreactivating enzyme restores the sedimentation coefficient of the superhelical DNA to its original value. Also, there is an approximate correlation between the fraction of thymines dimerized and the increase in s value. Titration of the superhelical twists in the irradiated and unirradiated DNA with ethidium bromide indicates that the uv light-induced increase in s value is accompanied by a decrease in the number of superhelical turns. The appearance of the superhelical DNA in electron micrographs is consistent with this conclusion. These experiments suggest that dimer formation and intercalation have the same effect on the structure of the DNA double helix, most probably that of partially unwinding the duplex. Each dimer formed appears to untwist the helix by approximately 5 to 6°. (auth)

21494 MECHANISMS OF RADIATION-INDUCED STRAND BREAK FORMATION IN DNA. Ward, J. F. (Univ. of California, Los Angeles). Contract AT(04-1)GEN-12. Israel J. Chem.; 10: No. 6, 1123-1138(1972).

The mechanisms by which γ radiation produces strand breaks in DNA were investigated using model systems: breakage of the sugar phosphate bond of deoxynucleotides irradiated in aqueous solution was equated to a reaction which would produce a strand break in DNA. Release of inorganic phosphate from 5'deoxynucleotides is caused by a radiation-produced hydroxyl radical abstracting a hydrogen atom from the deoxyribose moiety. Decay of the sugar radical so formed leads to phosphate release. After release of inorganic phosphate from deoxycytidylic acid two products are

formed which consist of the cytosine base moiety attached to two or three carbon atoms of the sugar. Radioprotective sulfhydryl compounds can repair the sugar radical by donation of a hydrogen atom to the damaged site. In thymidine 3'5' diphosphate, reaction of $OH^{\cdot}$ radicals with the base moiety as well as with the sugar can lead to inorganic phosphate release, both reactions leading to breakage of both 3' and 5' sugar phosphate bonds in the same molecule. When thymidine 3'5' diphosphate is irradiated in the presence of oxygen, labile phosphate esters are produced in yields which are large compared to the inorganic phosphate yield. Reaction of 5-bromouracil moieties in DNA with hydrated electrons can also lead to strand break production. Transfer of the electron to 5-bromouracil from the thymine anion radical was found to be an efficient reaction. Other species such as HCO_3^-, O_2^-, and the cytosine anion radical can also donate electrons to 5-bromo-uracil. The results and conclusions of these experiments are discussed with reference to reactions which could occur in DNA. (auth)

21495 IRRADIATION OF CHICKEN EGG WHITE. Fossum, K.; Underdal, B. (Veterinary Coll. of Norway, Oslo). Acta Vet. Scand.; 14: 118-128(1973).

Commercial ovomucoid trypsin inhibitors (OMTI) and egg white were exposed to various doses of gamma irradiation, using a cobalt-60 source. The inhibitory activity of nonirradiated and irradiated samples on bovine trypsin was tested by the Kunitz method. The activity of the inhibitors decreased exponentially with increasing radiation dose. The D_{10} for OMTI was 0.6 Mrad and for the trypsin inhibitors in the crude egg white diluted 1:5 in saline 3.0 Mrad under the conditions used. The activity of non-irradiated and irradiated inhibitors on various animal, microbial, and plant proteinases was also determined by using the crosswise casein precipitating inhibition test (cross-wise CPI-test). By this method, which is more sensitive than the Kunitz method, trypsin inhibitory activity in egg white could be detected after exposure to an irradiation dose of 9 Mrad. No inhibitory activity could be found against any enzyme after an irradiation dose of 15 Mrad. Irradiation as a preservation method for egg and egg products is discussed. (auth)

21496 ACTION OF IONIZING RADIATION ON THE HISTONE COMPONENT OF DNP. Rzendowska, F. Rocz. Panstw. Zakl. Hig.; 23: No. 6, 621-627(1972). (In Polish).

Aqueous fraction of deoxyribonucleoprotein (DNP) derived from calf thymus was irradiated in vitro with doses from 8000 to 24,000 R. The dose of 10,000 R and higher doses caused disappearance of one of five electrophoretic histone fractions rich in arginine. The number of thiol groups was determined in DNP-derived histones following radiation exposure to a dose of 10,000 R or higher; their number decreased by 70% as related to control determinations. (auth)

21497 ULTRAVIOLET LIGHT-INDUCED STABLE COMPLEXES OF DNA AND DNA POLYMERASE. Markovitz, A. (Stanford Univ., CA). Biochim. Biophys. Acta; 281: 522-534 (9 Nov 1972).

Previous studies demonstrated that DNA and DNA polymerase form a complex at low but not high ionic strength. Data presented show that the complex formed at low ionic strength is converted, by uv radiation, to a form that is stable to high ionic strength, to heat, and to 0.1 M NaOH. The uv-induced stable complex of the alternating copolymer poly(dA–dT) and DNA polymerase is heterogeneous in CsCl gradients and contains approximately one molecule of DNA polymerase per molecule of poly(dA–dT). The uv-induced stable complex of Escherichia coli DNA and DNA polymerase is more homogeneous in CsCl gradients and contains 1.6 molecules of DNA polymerase per molecule of double-stranded E. coli DNA. Studies with homopolymers indicate the uv-induced joining is not base specific. The formation of the complex is proportional to uv dose and to concentration of DNA polymerase at a given concentration of DNA or poly(dA–dT). Under optimum conditions, 65% of the E. coli DNA or 28% of the poly(dA–dT) could be obtained as stable complexes with DNA polymerase. (auth)

21498 ELECTRON BEAM EXCITATION AND DAMAGE OF BIOLOGICAL MOLECULES; ITS IMPLICATIONS FOR SPECIMEN DAMAGE IN ELECTRON MICROSCOPY. Isaacson, M. (Brookhaven National Lab., Upton, NY); Johnson, D.; Crewe, A. V. Radiat. Res.; 55: No. 2, 205-224(Aug 1973).

Radiation damage of various biological molecules is measured in an ultra-high vacuum scanning microscope. The damage measurements are made using radioinduced changes in electron energy-loss spectra and in electron diffraction patterns. Damage cross sections are compared with previously measured, inelastic electron-scattering cross sections. Using the measured damage doses, comparisons are made with the doses necessary for electron microscopy of biological specimens. (auth)

21499 INACTIVATION OF ALPHA-AMYLASE IN AQUEOUS SOLUTION BY GAMMA IRRADIATION. Tanabe, R. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 1, 31-36(Jan 1973).

The effects of γ irradiation on bacterial α-amylase in aqueous solution were studied. Inactivation of α-amylase by irradiation was caused by indirect action rather than direct. Among the various species of radiolytic products from water, H_2O_2 was not so effective, but OH radicals were very effective for inactivation of this enzyme. The optimum pH of the irradiated enzyme in enzyme reaction was similar to that of intact enzyme. (auth)

21500 INACTIVATION AND STRAND BREAK IN PHAGE DNA, AS INFLUENCED BY METASTABLE GASES. Luecke-Huhle, C.; Jung, H. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

In order to obtain exact data on the amount of energy required to induce macromolecular injuries in DNA it was investigated whether lower amounts of energy (between 4 and 20 eV) can be transferred to a molecule. This was achieved by two methods, namely by exposing the DNA to excited, metastable gas atoms that transfer the energy by collisions of the second kind, and by irradiation with short-wavelength uv light (vacuum uv). The equipment that was used to generate excited gases (helium, argon, or hydrogen) as well as other experimental details are briefly described. Following the exposure of the molecules, the biological inactivation of single- and double-strand DNA was determined by the protoplast test. Furthermore, the number of single strand breaks was measured in neutral and alkaline sucrose gradients using the preparative ultracentrifuge. The degree of inactivation and the number of strand breaks induced by uv irradiation of phage DNA were found to be the same in the energy ranges between 11 and 21 eV, independent of the quantum energy. The fact that the number of strand breaks in relation to the degree of inactivation was 60 to 80% for all gases indicates that in this case the reactions occurring above 4 eV are not determined by the amount of energy transferred. This does not apply to vacuum uv as it was found that the proportion of inactivated molecules due to strand breaks induced by irradiation at 11 to 21 eV is almost 100%. Below 11 eV, however, the number of strand breaks was found to decrease by more than three orders of magnitude. (GE)

21501 MOLECULAR BIOLOGICAL EXPERIMENT ON THE RADIOBIOLOGICAL EFFECT OF FAST NEUTRONS OF DIFFERENT ENERGY. Elmshaeuser, H. J. (Univ., Goettingen, Ger.). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

The results of previous investigations on the frequency of chromosome aberrations in anaphase cells of Allium cepa and the varying radiosensitivity over the various stages of the cell cycle could be interpreted by assuming a different effect on the synthesis of euchromatin and heterochromatin occurring at different times, so that the depth irradiation with fast electrons during the replication of the euchromatin (early S phase) will induce more aberrations than the surface irradiation, whereas on the other hand irradiation during the replication of the heterochromatin (late S phase) does not show any significant differences. The experiments described here were carried out in order to verify this hypothesis by demonstrating directly the radiation effect of a 15-MeV betatron on two chromatin fractions in meristem cells. For this purpose, two DNA fractions of different molecular weight or degree of binding, respectively, were prepared by a special gentle procedure, with the difference in the uptake of ^{3}H-labeled actinomycin D serving as a means to identify the two fractions as euchromatin and heterochromatin. The changes induced in these two fractions by the depth or surface irradiation were determined quantitatively by means of uv spectrophotometry. The results show that the two types of irradiation are inducing opposing chromic effects. (GE)

21502 INFLUENCE OF GAMMA-RADIATION ON THE STRUCTURE AND BIOLOGICAL ACTIVITY OF OXYTOCIN, A CYCLIC OLIGOPEPTIDE. Purdie, J. W.; Lynn, K. R. (National Research Council of Canada, Ottawa). Int. J. Radiat. Biol.; 23: No. 6, 583-589(Jun 1973).

During γ irradiation in aqueous solution under various conditions, the biological activity of oxytocin was lost exponentially, and the following D_{37} doses were found: aerated, 270 krads; deaerated, 230 krads; N_2O saturated, 170 krads; and deaerated + butanol, 440 krads. Thus, the hydroxyl radical appeared to be the principal inactivating species. Hydrolysis and analysis of irradiated hormone showed that cystine and tyrosine were the main residues affected.

Irradiated oxytocin was resolved into three fractions by gel filtration of Sephadex G-15. The first fraction, which was inactive, predominated in deaerated solution and appeared to consist of dimer or polymer. The third fraction was the major one from aerated and N_2O-saturated solutions and had a potency close to that of the original hormone. (auth)

21503 SENSITIVITY OF COLLAGEN TO IONIZING RADIATION: DEPOLYMERIZATION OF COLLAGEN IN ANIMALS OF DIFFERENT AGE. Svojtkova, E.; Deyl, Z.; Rosmus, J. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 31-34(1970). (In Czech).

The depolymerization of collagen was studied in insoluble lyophilized collagen prepared from inbred rats of Lewis strain of 1.5 months and 10 months old, respectively. Lyophilized collagen (ISC) was exposed to gamma radiation from a ^{60}Co source at a dose of 1.289×10^5 Rad/hr. The preparations of insoluble collagen obtained from older animals were found to be less susceptible to depolymerization induced by radiation. The depolymerization of the preparations from both old and young animals proceeded in two phases. In the first phase, collagen was depolymerized at alpha chain level. In the second phase, main polypeptidic chains of collagen split. The radiation dose needed to induce the effect was found to be dependent on the age of the animal. The cross-links accumulated in the collagenic structure with age were found to inhibit the two types of splitting reaction. (Nucl. Sci. Abstr. Czech.)

21504 EFFECTS OF RADIATION ON POLYNUCLEOTIDES. Setlow, R. B.; Setlow, J. K. (Oak Ridge National Lab., TN). Annu. Rev. Biophys. Bioeng.; 1: 293-346(1972).

Studies on the effects of ionizing radiation on polynucleotides are reviewed under the following headings: lethal and mutagenic effects; similarities to action of chemicals; the decay of incorporated radioactivity; measurement of chain breaks; rejoining of DNA strands in eukaryotes and bacteria; lesions in bacteriophage and purified DNA; and repair replication, unscheduled DNA synthesis, and DNA breakdown. Studies on the effects of nonionizing radiation on polynucleotides are reviewed under the following headings: photoproducts induced in nucleic acids by uv radiation; sensitization by incorporated BUDR; sensitization by psoralens; dependence of photochemical reactions of DNA conformation; energy transfer; in vitro dark repair of uv-damaged DNA; photoreactivation; DNA polymerase mutation and repair of uv-irradiated DNA; and post-replication repair of uv-irradiated DNA. (362 references) (HLW)

21505 EFFECT OF IN VIVO IRRADIATION ON RABBIT PLASMA LIPOPROTEINS. Dousset, N.; Feliste, R.; Carton, M.; Douste-Blazy, L.; Moscove, G. (Institut National de la Sante et de la Recherche Medicale, Toulouse). Ann. Biol. Clin. (Paris); 31: No. 2, 109-110(1973). (In French).

From 10th western European symposium on clinical chemistry; Strasbourg (15 Apr 1973).

Rabbits were given a total exposure of 800 roentgens in the form of a single dose. In the 24 hours following irradiation, a quantitative evaluation of the lipoproteins was effected by electrophoresis and two different types of response were distinguished in terms of the hypertriglyceridemia, the threshold of the latter being 10 grams. In the first group a decrease in the α lipoproteins was observed after the 11th hour; after 24 hours almost all the lipoproteins were observed in the β form and the pre-β lipoprotein form. In a second group, the modifications occurred earlier and after the 16th hour an almost complete disappearance of α and β lipoproteins was observed. (FR)

21506 THYMINE HYDRATE FORMED BY ULTRAVIOLET AND GAMMA IRRADIATION OF AQUEOUS SOLUTIONS. Fisher, G. J.; Johns, H. E. (Univ. of Toronto). Photochem. Photobiol.; 18: No. 1, 23-37(Jul 1973).

Evidence is presented for the formation of a thymine hydrate upon ultraviolet (uv) or gamma irradiation of aqueous solutions. The uv quantum efficiency exhibits a dependence on pH similar to that shown for uracil hydration, but the yield is three orders of magnitude smaller than for uracil. Hydration is not affected by wavelength, oxygen, or thymine concentration. The reversal rate of the photohydrate to thymine is similar to the reversal rates of both isomers of the thymine hydrate formed by γ radiolysis and depends on pH in the same way as the rate for the uracil photohydrate. The photohydrate of thymine is chromatographically identical to the cis isomer of 6-hydroxy-5,6-dihydrothymine. (auth)

21507 ULTRAVIOLET IRRADIATION OF NUCLEIC ACIDS COMPLEXED WITH HEAVY ATOMS. 3. Influence of Ag^+ and Hg^{2+} on the Sensitivity of Phage and of Transforming DNA to Ultraviolet Radiation. Rahn, R. O.; Setlow, J. K.; Landry, L. C. (Oak Ridge National Lab., TN). Photochem. Photobiol.; 18: No. 1, 39-41(Jul 1973).

The influence of the heavy metal ions Ag^+ and Hg^{2+} on the photoinactivation and photodimerization of transforming DNA and of bacteriophage was studied. The rate of inactivation of Haemophilus influenzae transforming DNA by ultraviolet (uv) radiation was enhanced by a factor of 30 when it was complexed with Ag^+. This enhancement was correlated with a comparable increase in the rate of thymine dimerization. In contrast, mercuric ions led to a reduction in the rates of both inactivation and dimerization. When the effects of these metal ions on the photobiology of bacteriophage were examined, it was again found that Ag^+ enhanced and Hg^{2+} reduced the rate of uv inactivation. These results demonstrate that heavy metals may be useful tools for studying the photochemistry and photobiology of nucleic acids. (auth)

21508 ULTRAVIOLET IRRADIATION OF NUCLEIC ACIDS COMPLEXED WITH HEAVY ATOMS. 2. Phosphorescence and Photodimerization of DNA Complexed with Ag. Rahn, R. O.; Landry, L. C. (Oak Ridge National Lab., TN). Photochem. Photobiol.; 18: No. 1, 29-38(Jul 1973).

The luminescence (at 77°K) and photochemistry (at 298°K) of a variety of polynucleotides complexed with Ag^+ were studied. In all cases it was observed that Ag^+ induces a heavy atom effect as indicated by quenching of fluorescence, enhancement of phosphorescence, and reduction of triplet lifetimes. The enhancement by Ag^+ of the phosphorescence intensity of poly (dT) and DNA paralleled a 20-fold enhancement of the rate of thymine dimerization. These results suggest a possible triplet precursor for thymine dimerization in Ag^+ complexes. Dimers were also made with a variety of triplet sensitizers, and Ag^+ increased the dimer yield two- to four-fold, depending on the sensitizer used. (auth)

21509 ACETONE-SENSITIZED PHOTOINACTIVATION OF TRANSFORMING DNA. Pons, F. W.; Mennigmann, H. D. (Univ., Frankfurt am Main). Photochem. Photobiol.; 18: No. 1, 17-22 (Jul 1973).

Irradiation of Haemophilus influenzae transforming DNA with 313 nm radiation in the presence of acetone leads to inactivation of transforming activity. Some of the lesions produced are substrate for photoreactivating enzyme and the dark-repair mechanism. In addition, other lesions are produced which, if their production is not prevented by the presence of EDTA during irradiation, render the DNA less photoreactivable. The possibility is discussed that, among others, single-strand breaks are responsible for this loss in photoreactivability. (auth)

21510 REPAIR OF DAMAGE INDUCED IN ΦX174 RF-DNA BY ^{60}Co-GAMMA RAYS. Stephan, G. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 23: No. 6, 533-542(Jun 1973).

The covalently closed double-stranded RFI-DNA of phage ΦX174 was gamma-irradiated over a range of 0 to 700 krads. Molecules with radiation induced-single-strand breaks (RFII-DNA) were separated by sedimenting in a sucrose-gradient from radiation damaged RFI-DNA not having suffered single-strand breaks. The surviving fractions of both types of DNA were assayed on hcr^+ and hcr^- spheroplasts. Roughly 50% of the radiation lesions in RFI-DNA could be eliminated by host-cell reactivation, whereas the radiation induced RFII-DNA showed the biological activity of unirradiated RFI-DNA. It is suggested that this unexpected behavior may be due to a dark reactivation system different from the excision repair. Radiation induced single-strand breaks appeared not to be correlated with lethality. Furthermore it is shown that the total mass of both the single-stranded phage DNA and the double-stranded RFI-DNA represents the radiation critical target. (auth)

21511 INFLUENCE OF X RADIATION AND THE PHOTODYNAMIC EFFECT ON THE BIOSYNTHESIS OF RNA AND PROTEINS IN SACCHAROMYCES CELLS. Lochmann, E. R.; Pietsch, I.; Micheler, A. (Freie Univ., Berlin). (1972). vp. (In German).

From joint meeting of the German society for biophysics and the German society for medical physics; Erlangen, Germany (4 Oct 1972).

Metabolic processes were not impaired immediately after irradiation but slightly activated. Inactivation of biosynthesis, not before 1 cell cycle (2 hrs), was caused by damage to DNA. The dye thiopyronine and visible light led immediately to a significant decrease of RNA and protein synthesis. Possible repair occurred after a few hours. Photodynamic treatment of different fractions of Saccharomyces system for cell-free protein synthesis indicated sensitivity of ribosomes to the photodynamic effect. (GE)

21512 RADIATION-INDUCED DNA-STRAND SCISSIONS IN BACTERIAL CELLS AND THEIR REPAIR. Kitayama, S.; Igarashi, K.; Kano, H.; Koyama, H.; Kojima, Y. (Inst. of Physical and Chemical Research, Wako, Japan). Shokuhin Shosha; 6: No. 1, 21-26(Jan 1971). (In Japanese).

In correlation with the radiation killing of bacterial cells, DNA-strand scissions and their repair during postirradiation incubation were investigated by the sedimentation analysis using neutral (for double-strand scissions) and alkaline (for single-strand scissions) sucrose gradients. Radioresistant strains, Micrococcus radiodurans and Escherichia coli B/r, were employed as the test organisms. Double-strand scissions in DNA were estimated to occur at the rate of one double cut per 800 eV. This rate is in a good agreement with the values reported for other types of bacterial and mammalian cells. The rejoining of these double-strand scissions was observed during the repair process of the postirradiation incubation and the mean rejoining time was found to be about 50 minutes. This rejoining repair was inhibited by adding chloramphenicol, tetracycline, or actinomycin D to the postirradiation incubation medium. M. radiodurans cells were also found to lose their colony-forming ability when the postirradiation incubation was carried out in the presence of these inhibitors of protein or RNA synthesis. Thus, it is suggested that the high resistance of M. radiodurans to gamma rays may be due to the capacity of this rejoining repair. Although similar results were obtained with E. coli B/r, the radiation lethal effect could not be fully explained by the result of the sedimentation analysis. The sedimentation patterns of DNA from irradiated E. coli B/r indicated that there might be a possibility of the repair of double-strand scissions in DNA detected by the current technique. Studies should be done to establish the relationship between radioinduced DNA strand breaks and the radiation lethal effects. (JA)

Radiation Effects on Cells

Refer also to abstract 21696.

21513 (ORNL-4902(Vol.1), pp 14-16) CALCULATION OF SPATIALLY DEPENDENT CELL-SURVIVAL PROBABILITIES. Armstrong, T. W.; Chandler, K. C. Aug 1973.

In Neutron Physics Division annual progress report for period ending May 31, 1973.

21514 MORPHOLOGY OF MITOCHONDRIA OF IRRADIATED L CELLS. Tkadlechek, L.; Tsibulka, M.; Plkhova, Sh.; Spurna, V. Med. Radiol.; 18: No. 7, 34-41(Jul 1973). (In Russian).

L cells (fibroblasts of mice), growing in the monolayers on glass, were irradiated by x rays in doses of 100, 380, 1000, 3300, 10,000, and 33,000 rad. Native preparations were studied 5, 15, and 60 min and 2, 3, 6, 24, 48, 72, or 96 hrs following irradiation with phase contrast through a luminescence microscope, and ultra thin sections through an electron microscope in about 48 hours. Irradiation of the cells caused changes in the length and forms of mitochondria, disorders in their external membranes, swelling, and later thickening of the matrix and its vacuolization. The dynamics of these changes and character of dependence of disorders on the dose of irradiation do not correspond to the importance of L cell damage by irradiation, the consequence of which is the loss of their reproductive ability. Therefore, it is possible to regard mitochondria of fibroblasts as not belonging to structures being a critical site for primary radiation injury. (auth)

21515 PSORALEN PLUS NEAR ULTRAVIOLET LIGHT INACTIVATION OF CULTURED CHINESE HAMSTER CELLS AND ITS RELATION TO DNA CROSS-LINKS. Ben-Hur, E.; Elkind, M. M. (Brookhaven National Lab., Upton, NY). Mutat. Res.; 18: No. 3, 315-324(Jun 1973).

The survival curve of Chinese hamster cells exposed to near ultraviolet (NUV) light in the presence of 4,5′,8-trimethylpsoralen exhibits a pronounced shoulder, i.e., cells accumulate sublethal damage before survival decreases exponentially. During incubation between fractionated exposures, the cells are able to recover their capacity to accumulate sublethal damage, although at a slower rate than after x irradiation. Synchronized cells demonstrate a pronounced age-response variation, similar to that of x-irradiated cells, in which maximum resistance occurs in the second half of the S phase. During a second NUV exposure without psoralen, following a first treatment consisting of psoralen-plus-NUV, only DNA cross links are produced. Using this procedure a correlation was found between cell killing and the production of DNA crosslinks. (auth)

21516 FRACTIONATED RADIATION RESPONSE OF HUMAN CELLS IN STATIONARY AND EXPONENTIAL PHASES OF GROWTH. Zinninger, G. F.; Little, J. B. (Harvard Univ., Boston). Radiology; 108: No. 2, 423-428(Aug 1973).

Stationary phase cultures of human cells have several growth characteristics of malignant tumors in vivo including slowly proliferating and nonproliferating but potentially clonigenic cell populations, and a cell loss factor. Two characteristics of radiation response of stationary cells are an unusual sensitivity to the initiation of DNA synthesis, and their ability to repair potentially lethal radiation damage. The responses of simple exponentially growing cultures and stationary phase cultures to various schedules of fractionated irradiation were compared. The results suggest that small-fraction, protracted irradiation will preferentially kill cells in stationary cultures which are capable of repairing potentially lethal damage; exponentially growing cells are incapable of such repair. (auth)

21517 SENSITIZING EFFECT OF PROTRACTED IRRADIATION. Liversage, W. E. (Charing Cross Group of Hospitals, London). Brit. J. Radiol.; 46: No. 547, 564-565(Jul 1973).

Comment is made on the explanation given by Kal and Barendsen (Brit. J. Radiol.; 45: 279-283 (1972)) of their observed effects of continuous irradiation at low dose-rates on a rat rhabdomyosarcoma that cells surviving a low dose-rate treatment with 2,000 rads of γ rays in 20 hrs were more sensitive to subsequent x-ray treatment than cells in unirradiated tumors. It is considered that an alternative and simpler explanation of the increased sensitivity observed is that during the protracted irradiation the surviving tumor cells accumulated a considerable amount of sub-lethal damage, most of which would still be present at the time of the acute irradiation. The cells surviving the protracted irradiation would have accumulated a quantity of sub-lethal damage equal to that present immediately after an acute dose of 216 rads. Examination of the relevant acute cell survival curve shows that this amount of sub-lethal damage is adequate to explain the increased sensitivity reported by the above authors. (UK)

21518 N-ETHYLMALEIMIDE AND THE CYCLIC RESPONSE TO X-RAYS OF SYNCHRONOUS CHINESE HAMSTER CELLS. Sinclair, W. K. (Argonne National Lab., IL). Radiat. Res.; 55: No. 1, 41-57(Jul 1973).

In addition to DNA synthesis, at least one other factor appears to exert a controlling influence on the cyclic dependence of the lethal radiation damage in mammalian cells. Experiments designed to identify this factor were conducted with the sulfhydryl binding agent, N-ethylmaleimide (NEM) in synchronous Chinese hamster cells. Low concentrations of NEM (0.75 μM) sensitize oxygenated Chinese hamster cells most in the late S period. The effect is primarily on the slope of the survival curve, rather than its shoulder, and the maximum sensitization factor for late S cells is about 1.6. Experiments with NEM and cysteamine indicate that NEM forms a stable complex in the cell, and thus exposure to NEM before irradiation sensitizes the cell equally well as when NEM is present during irradiation. The sensitizing effect is less the longer the interval between pretreatment with NEM and irradiation. N-ethylmaleimide also has a pronounced postirradiation effect: when given immediately after irradiation, the effect is the same as for pretreatment or during irradiation. The effect decreases in magnitude with time for up until 2 hours after irradiation in late S cells and for longer times in the case of G_1 cells. N-ethylmaleimide also suppresses the rise in survival normally seen late in the cell cycle of cells inhibited by hydroxyurea from synthesizing DNA and thus presumably modifies a factor that controls cell survival in the absence of DNA synthesis. Late S cells irradiated in the presence of NEM have the same capacity to recover from sublethal damage as do untreated cells. These results suggest that when oxygenated cells are exposed to a low concentration of NEM, for some time, repair of lethal damage is inhibited. The mechanism by which NEM accomplishes this inhibition is not known, since the evidence as to whether the -SH binding is involved is conflicting and other actions of NEM also take place. (auth)

21519 FRACTIONATED ULTRAVIOLET LIGHT IRRADIATION OF CULTURED CHINESE HAMSTER CELLS. Todd. P. (Pennsylvania State Univ., University Park). Radiat. Res.; 55: No. 1, 93-100(Jul 1973).

Two cultured lines of Chinese hamster cells M3-1 (near-euploid) and V79-79 (21 chromosomes) were exposed to conditioning doses of ultraviolet light (uv) of 254 nm, and their ability to survive a second exposure was studied as a function of time after the conditioning exposure. Colony formation was used as the end-point for survival. In partially synchronous cultures, cells of line M3-1 exhibited higher survival after fractionated than after single exposures; however, the higher survival was detectable only if a DNA-synthesis phase (greatly prolonged by the conditioning exposure) was allowed to intervene between the first and second exposures. Cells of line V79-79 also exhibited higher survival when the exposure was fractionated than when it was delivered as a single dose. Caffeine, when present between exposures at 1 mM concentration, did not affect the increase in survival of M3-1 cells. Postirradiation caffeine reduced survival of M3-1 cells after single exposures. These observations are interpreted to indicate that cultured Chinese hamster cells are capable of recovering from sublethal injury by uv light

if a DNA-synthesis phase occurs between exposures. Caffeine does not appear to interfere with this recovery process. (auth)

21520 CELL CYCLE SPECIFIC RECOVERY FROM FRACTIONATED EXPOSURES OF ULTRAVIOLET LIGHT. Domon, M.; Rauth, A. M. (Univ. of Toronto). Radiat. Res.; 55: No. 1, 81-92(Jul 1973).

Previous studies, using caffeine, indicated that a deoxyribonucleic acid (DNA) synthesis period (S phase)-dependent potentiation of ultraviolet light (uv) damage occurs in mouse L cells, but the question remains whether this potentiation is due to a peculiar interaction of caffeine with irradiated cells or whether it is due to interference with a recovery process that can be demonstrated in the absence of the drug. To answer this question synchronized populations of L cells were exposed to various first exposures of uv. As a function of time after this initial exposure survival curves of cell colony-forming ability were determined. Results indicate that cells surviving the initial exposure delivered in G_1 phase, which pass through S phase, show no effect of this exposure when irradiated in G_2 phase. That is, the survival curve for such cells in G_2 is the same as for cells irradiated in G_2 phase that have not been irradiated in G_1 phase. Conversely, cells exposed to uv in G_2 phase and allowed to progress to G_1 phase are more sensitive to uv than cells in G_1 phase, which are not preirradiated in G_2 phase. If these same cells are allowed to pass through S phase, they recover completely from the previous G_2 irradiation. These results are consistent with the hypothesis that uv-irradiated cells recover from damage during their first passage through S phase. (auth)

21521 MECHANISM OF ONCOGENIC TRANSFORMATION BY ROUS SARCOMA VIRUS. III. Role of Proviral DNA in Morphologic Conversion of Chicken Embryo Fibroblasts. Balduzzi, P. C. (Univ. of Rochester, NY). J. Virol.; 12: No. 2, 284-290(Aug 1973).

Multiplication of Rous sarcoma virus and morphological conversion of chicken embryo fibroblasts are mediated by a DNA provirus. The role of the provirus in induction of morphological conversion was shown by experiments of light inactivation of bromodeoxyuridine (BUdR)-sensitized proviral DNA. In the experiments reported, inactivation of focus formation by BUdR and light could be obtained in cells in which the ability to produce virus has become resistant to x irradiation. This property is considered to reflect the integrated state of the provirus. These experiments indicate that the role of proviral DNA extends beyond induction of morphological conversion and that an intact provirus is required for the maintenance of the transformed state. These experiments also indicate that no irreversible process leading to morphological conversion is initiated by a nonintegrated or by an integrated provirus. (auth)

21522 RESPONSE OF CELLS TO FAST NEUTRONS, STOPPED PIONS, AND HEAVY ION BEAMS. Katz, R.; Sharma, S. C. (Univ. of Nebraska, Lincoln). Nucl. Instrum. Methods; 111: No. 1, 93-116(1973).

The delta-ray theory of the inactivation of cells by energetic heavy ions, shown earlier to represent experimental survival curves for bacterial spores, haploid yeast, Hela, Chinese hamster, and T-1 human kidney cells, in the cellular grain-count regime (where inactivated cells are strung on the path of a heavy ion) is here extended to bacteria, diploid yeast, leukemia cells, and the cellular track-width regime (where even cells which are not intersected by the ion's path are activated, by energetic delta-rays). When the four cellular radiosensitivity parameters of the model are known for a cellular variety in a specific set of ambient conditions, the model may be applied to the evaluation of cellular survival in an arbitrary radiation environment, for which the secondary particle spectrum is known or negligible. For such a mixed environment, the solution to the problem of cellular survival is formulated in general terms, and is then made specific to 14 MeV neutrons, stopped pions (as in the Bragg peak of a pion beam), and heavy ion beams. Calculated survival data for 14 MeV neutrons and energetic nitrogen beams are compared to existing data. Difficulties arising from the use of incomplete parameterizations of experimental data (based on the assumption that response is a single valued function of LET, and so on) are discussed. (auth)

21523 REPAIR OF POTENTIALLY LETHAL LESIONS IN X-IRRADIATED, DENSITY-INHIBITED CHINESE HAMSTER CELLS: METABOLIC EFFECTS AND HYPOXIA. Hahn, G. M.; Bagshaw, M. A.; Evans, R. G.; Gordan, L. F. (Stanford Univ., CA). Radiat. Res.; 55: No. 2, 280-290(Aug 1973).

Plateau phase Chinese hamster cells (HA-1), growing in monolayers, form a convenient system for studying the repair of potentially lethal damage. Cells are irradiated under conditions of density inhibition, and the interval between irradiation and explant (to assay survival) is varied. Repair is evidenced by higher survival of those cells maintained in plateau. This increase in survival can be expressed as a slope-modifying factor. The magnitude of the slope-modifying factor is determined by the cells' post-irradiation environment. Cells overlaid with Hanks' BSS in the interval between irradiation and explant showed a maximum slope-modifying factor (~1.3), cells in serum free or conditioned medium a somewhat lower value, while minimum repair was seen if the cells were in fresh medium supplemented with fetal bovine serum. Hypoxia does not seem to affect the magnitude of repair of potential lethal damage if the comparison of survival increase is made at similar survival (rather than dose) levels. Cells in G_1 repair potential lethal damage actively and account for most, if not all, of the increase in survival. The rate of repair has a half-time of 1 to 2 hours, both in aerobic and in hypoxic cells. Repair is essentially complete after 6 hours. Exponentially growing cells show little or no evidence of repair under similar conditions and over a similar time interval. (auth)

21524 EFFECTS OF TEMPERATURE ON THE DYING PROCESS OF LETHALLY IRRADIATED CULTURED MOUSE MAMMARY CARCINOMA CELLS. Okumura, Y.; Morita, T.; Matsuzawa, T. (Aichi Cancer Center Research Inst., Nagoya, Japan). Radiat. Res.; 55: No. 2, 318-323(Aug 1973).

The ability of mouse mammary carcinoma cells, FM3A, to stain with trypan blue was evaluated as a function of time after x-irradiation with 1 to 30 krad. The number of unstainable cells did not change for the first 40 hr after 3 to 10 krad; thereafter the number of viable cells decreased exponentially with a mean lethal time of 33.6 hr. Control and irradiated cells were incubated at 37, 31, and 28°C, and the doubling time and mean lethal time showed the same temperature dependence, so that the activation energy for the expression of this type of radiation damage was the same as the activation energy for cell growth, suggesting that the expression of the damage requires cell metabolism. (auth)

21525 INFLUENCE OF IONIZING RADIATIONS ON THE COLONY SIZE DISTRIBUTION OF CHO-FIBROBLASTS. Toellner, D.; Hagemann, G.; Stender, H. S. (Medizinische Hochschule, Hanover). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

Previous investigations on ovarial cells of hamsters have shown that the dead cells occurring after irradiation can be divided into at least three different groups, namely those due to reproduction death, to interphase death at high doses, and to interphase death at low doses. The population kinetics is thus essentially determined by these three different lethal dose effects. This phenomenon can be interpreted by means of the survival curve that can be determined either for colonies or for cells. The two survival curves differ from each other as a result of the effect produced by the reproduction death on the cell population kinetics. Hence the survival curves for colonies and cells were compared using identical colony size spectra. A heterogeneous CHO-cell population was subjected to 200 kV x rays at a dose rate of 64 rad/min, with the evaluation following 77 hrs after the irradiation. It is shown that the cell survival curves can be easily calculated from the colony size distribution and the colony survival curve. It is likewise shown to what extent the lower limit of summation in the summation of the colony size distribution influences the course of the survival curves. (GE)

21526 GROWTH FRACTION AND CELL CYCLE TIME OF GAMMA-IRRADIATED MAMMALIAN CELLS. Sasaki, S. (Tohoku Univ., Sendai). Tohoku J. Exp. Med.; 108: No. 3, 225-237(Nov 1972).

Population kinetic analysis was made for growth fraction and median cell cycle time over 9 days after irradiation of a mouse mammary tumor cell population (FM3A) treated with 500 and 700 R of ^{60}Co gamma rays, where the growth fraction was estimated from labeling indices determined by the staggered addition method with ^{3}H-thymidine and colchicine, and the median cell cycle time from the rate of c-mitosis accumulation by colchicine as well as the growth fraction. The analysis revealed a modest proliferation of the median cell cycle time of proliferating cells in the gamma-irradiated population. Irrespective of the doses of irradiation, the most remarkable reduction in the growth fraction was noted to occur on the third day of irradiation. The data obtained indicate that the diminution of the rate of increase in total cell number is derived primarily from decrement of the growth fraction and not largely attributable to prolonged cell cycle time, and the decline in the growth fraction is due to departure from the cell cycle and/or death of the cell. (auth)

21527 BIOLOGICAL EFFECTS OF AUGER EMITTERS. Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.); Tisljar-Lentulis, G.; Scaife, J. F.; Burki, H. J.; Roots, R.; Bond, V. P. (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

Investigations were made on the biological effectiveness of ^{125}I-deoxyuridine in V79 cells of Chinese hamsters and in L 5178 Y leukemia cells of mice because these cells show a different radiosensitivity. The survival curves of the cells exposed to Auger emitters after deep freezing were compared with those of cells labeled with ^{3}H-deoxyuridine or ^{3}H-thymidine and with the curves of cells exposed to x rays after deep freezing. The survival curves derived after incorporation of tritium are similar to those determined after x-ray exposure but are nevertheless different for the two cell types. In the case of labeling with ^{125}I, however, the curves of the two cell types differ only slightly. The decay of ^{125}I was found to be seven times more toxic than the decay of ^{3}H. After the incorporation of non-radioactive iodine- or bromodeoxyuridine into the DNA, the Auger effect can be induced in these atoms by means of x rays with energies corresponding to the k-absorption constants of iodine or bromine, upon which its influence on the DNA can be compared with the effects produced by the decay of ^{125}I. The theoretical principles and conditions of such investigations are discussed along with the possibilities opened up by this method for clinical therapeutics. (GE)

21528 EFFECT OF REPEATED DOSES OF X RAYS ON THE SURVIVAL AND SYNTHESIS OF DNA FROM CANCEROUS HUMAN EXPLANTS MAINTAINED IN LONG DURATION CULTURES. Beaupain, R. (CNRS, Nogent-sur-Marne, France). Compt. Rend., Ser. D; 276: No. 12, 1925-1928(19 Mar 1973). (In French).

The application of two 300 R doses of x rays does not have any lethal effect on Z 200 nodules and results in a higher survival rate than a single 600 R dose. The existence of a repair process is thus confirmed. Two 600 R irradiations are lethal. The incorporation of tritiated thymidine is less significant in the case of nodules having received fractionated doses. The reduction in the quantity of tritiated thymidine incorporated increases with the time interval between the 2 doses. (FR)

21529 EFFECT OF RADIATION ON THE METABOLISM OF NUCLEIC ACIDS. Grozdanovic, J.; Vich, Z.; Truxova, G.; Kratochvil, J. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 29-30(1970). (In Czech.).

The effect of radiation on the metabolism of nucleic acids, mainly in the early phases of the synthesis of nucleic acids induced by the elimination of nucleic acid precursors after the application of 6-azauridine (6-AzUR), was studied. The experiments were carried out in the mouse Ehrlich ascites carcinoma. The cells of the mouse Ehrlich ascites carcinoma and immunized cells were found to differ in their reaction to the combined application of 6-azauridine and irradiation. The antagonism between the two therapeutic factors was observed in the tumor cells while synergism was observed in the reticulo-endothelial cells. This may be significant in clinical practice. The toxic effect of nuclides as heavy metals is believed to influence the inhibitory effect of internal nuclides of a heavy metals type. Examinations of uranium miners only showed a slightly increased deoxycytidinuria (within physiological limits) directly related to age. (Nucl. Sci. Abstr. Czech.)

21530 ABSENCE OF A FRACTIONATION EFFECT IN IRRADIATED HeLa CELLS. Nias, A. H. W.; Swallow, A. J.; Keene, J. P.; Hodgson, B. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 23: No. 6, 559-569 (Jun 1973).

Aerated and hypoxic HeLa cells were exposed to single and split doses of radiation using pulses of fast electrons and conventional x radiation over a range 0 to 2400 rads. With aerated cells, the single dose survival curves exhibited a shoulder with both types of radiation, before becoming exponential, but no fractionation effect was observed in the experiments with fast electrons, although one was found with x rays. For cells under conditions of extreme hypoxia, the single-dose survival curves were exponential both with electron pulses and with x rays, and split-dose experiments showed no fractionation effect. (auth)

21531 X-RAY-INDUCED DELAY IN THE CHINESE HAMSTER CELL CYCLE: DEPENDENCE ON PHASE IRRADIATED UNDER DIFFERENT CULTURING CONDITIONS, BUdR INCORPORATION, AND HYPERTONIC TREATMENT. Miller, D. R.; Dewey, W. C.; Miller, H. H. (Colorado State Univ., Fort Collins). Int. J. Radiat. Biol.; 23: No. 6, 591-602(Jun 1973).

Chinese hamster ovary (CHO) cells, synchronized by selecting mitotic cells, received 300 rads of x radiation at various intervals during the cell-cycle and were examined for cell number until they had completed their next wave of division. These growth curves were analyzed for division delay in relation to type of media, i.e., modified Ham's F-10 or modified McCoy's 5 a, and to culturing conditions, i.e., monolayer or suspension. Regardless of the type of media or culturing conditions used, mitotic cells were delayed somewhat longer (0.55 min/rad) than early-mid G_1 cells, and then the delay increased with cell age from early-mid G_1 (0.32 min/rad) to late S-early G_2 (0.84 min/rad). Thus, radiosensitivity during the cell-cycle approached in late S phase a maximum for division delay in contrast to a minimum for cell killing and chromosomal aberrations. Furthermore, division delay was not increased by either incorporating bromodeoxyuridine into the DNA or treating the cells with hypertonic medium, although each of these treatments increased mortality and chromosomal aberrations by factors of 1.45 to 2.0. All this evidence suggests that the site of action involved in x-ray-induced division delay differs from that involved in chromosomal aberrations and cell killing. (auth)

21532 RADIOSENSITIVITY OF PARASYNCHRONIZED MAMMALIAN CELLS AT VARIOUS STAGES OF CELL CYCLE. Ahmed, K. (Atomic Energy Medical Centre, Chittagong, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 77-81(Apr 1972).

A study was carried out to see the radiosensitivity of two mammalian cell lines, namely, mouse fetal liver cells and HeLa cells at various stages of the cell cycle. The parasynchronized cells were irradiated with a single dose of 400 rads of 250 KVP at the dose rate of 100 rads per min, at various time intervals. The differences observed between the single dose age-response function of mouse fetal liver cells and HeLa cells seems to be mainly in the DNA presynthetic period G_1. The G_1 period in the HeLa cells is considerably longer than those of mouse fetal liver cells. The results obtained are discussed in the light of similar work done in other laboratories. The aim of these studies was to point out the significance of influence of biochemical activities on the radiosensitivity of cells at various stages of the division cycle. These findings are of some importance in explaining some of the phenomena relating to the radiation effects and recovery in studies of radiobiology especially irradiation of a tissue or a population of cells in vitro. (auth)

21533 INFLUENCE OF IONIZING RADIATION ON THE COLONY SIZE DISTRIBUTION OF CHO-FIBROBLASTS. Toellner, D.; Hagemann, G.; Stender, H. St. (Medizinische Hochschule, Hanover). Strahlentherapie; 145: No. 5, 604-611(1973). (In German).

In the determination of survival curves of irradiated CHO-cells on the basis of the capability of forming colonies, such microcolonies are not considered that could have developed through reproductive death. An evaluation was made to determine if the survival curves of colonies and cells are influenced by this kind of evaluation. The spectrum of the size and the total number of colonies was determined under radiation doses of 100, 200, 300, 500, 650, and 800 rad. The survival curves of colonies and cells were compared under the assumption of different cell-number limits of the colony sizes. The great differences found indicate that the microcolonies, determined by these cell-number limits, influence the course of the survival curves of cells and colonies in a different degree. Therefore, the radiation effects on the colony-forming cells cannot be derived generally from the survival curves of their colonies. (GE)

21534 ESTIMATIONS OF THE RBE FOR π^- AND π^+ FROM SURVIVAL DATA OF T-1 HUMAN KIDNEY CELLS. Dutrannois, J. R.; Wright, H. A.; Turner, J. E.; Hamm, R. N. (European Organization for Nuclear Research, Geneva). Int. J. Radiat. Biol.; 23: No. 5, 421-434(May 1973).

A Monte Carlo program was written for computing depth–dose distributions in water phantoms irradiated by positive and negative pion beams. Contributions to the dose from the primary pions and various secondary particles are tabulated. Their contributions were weighted by a set of RBE values obtained from biological experiments. In particular, estimates of the average RBE for survival of T-1 human kidney cells (at approximately the 10% level) were carried out as functions of depth along the center line for typical π^- and π^+ beams. Isodose curves are plotted for π^- beams. Examples of the variations in average RBE with changes in the mean momentum and momentum spread of the beam are also calculated. Comparisons are made with some observed effects produced by pions on biological systems. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 21484, 21500, 21504, 21507, 21511, 21512, and 21836.

21535 (CONF-721091-, pp P17.p1-P17.p6) APPLICATION OF IONIZING RADIATION TO THE PRESERVATION OF SUBTROPICAL FRUIT IN SOUTH AFRICA. Brodrick, H. T.; Jacobs, C. J.; Kok, I. B.; Milne, D. L.; Basson, R. A.; Thomas, A. C. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

The more important diseases and pests of stored mangoes in South Africa are anthracnose, soft brown rot, and the mango weevil. Results reported in this paper indicate that soft brown rot cannot be successfully controlled with gamma irradiation. Results on the control of anthracnose with irradiation were inconclusive, although irradiation seemed to improve the effect when used together with hot water dip treatments. Gamma irradiation at rates of less than 100 krad was found to be fairly successful in controlling weevil activity in general, and a mortality figure of 87% was obtained for adult weevils. A dose of more than 100 krad has been found to be phytotoxic and therefore unsuitable for practical application under the conditions described in these experiments. (auth)

21536 (COO-3411-10) BASIC ASPECTS OF ACTION OF RADIATION ON MICROORGANISMS. Final Report for the Period Ending August 31, 1972. Pollard, E. C. (Pennsylvania State Univ., University Park. Dept. of Biophysics). 1973. Contract AT(11-1)-3411. 12p. Dep. NTIS $3.00.

A review of the history of the project includes discussions of studies on the use of radiation to study the structure of the bacterial cell and studies on radioinduced DNA degradation. Recent studies were concerned with effects of introducing irradiated T4 DNA into a variety of cells, directly produced DNA degradation in the same set of mutant cells, studies on an inhibitor of DNA degradation, effects of radiation on transcription, and analysis of these effects by target theory. Factors to be considered in assessing radiation damage to microorganisms are mechanisms of cell death, mechanisms of cellular recovery from damage, and mechanisms of cellular protection against damage. (HLW)

21537 SEROLOGICAL PROPERTIES OF MUTANTS OF RHIZOBIUM. Kaushik, B. D.; Dadarwal, K. R.; Venkataraman, G. S. (Indian Agricultural Research Inst., New Delhi). Curr. Sci. (India); 42: No. 14, 508-509(20 Jul 1973).

The serological characterization of some uv-radioinduced mutants of Rhizobium trifolii and R. leguminosarum as well as that of a recombinant and transformant strain of the latter is described. (ERB)

21538 ACTIVATION OF NISIN PRODUCTION OF UV-IRRADIATION IN A NISIN-PRODUCING STRAIN OF STREPTOCOCCUS LACTIS. Kalra, M. S.; Kuila, R. K.; Ranganathan, B. (National Dairy Research Inst., Karnal, India). Experientia; 29: No. 5, 624-625(15 May 1973).

Cultures of Streptococcus lactis were uv-irradiated and survival curves were prepared. An uv dose of 9,000 ergs/mm^2 gave less than 1% survival and mutants were isolated. Definite increases in nisin production to the extent of 50 and 100% were evident after the first and second treatment with uv. After the third treatment a downward trend in nisin production was noticed. (HLW)

21539 REVERSION OF CISTRON A AMBER MUTANTS OF BACTERIOPHAGE φX174 BY IONIZING RADIATION. Bleichrodt, J. F.; Verheij, W. S. D. (Medical Biological Lab TNO, Rijswijk, Netherlands). Mutat. Res.; 18: No. 3, 363-365(Jun 1973).

Amber mutants of bacteriophage φX174 can be reverted by ionizing radiation to pseudo wild-type particles, i.e., particles able to propagate in a suppressorless host. Since the DNA of φX 174 is single-stranded, mutation cannot be due to errors in repair of radiation damage by the excision repair or by the recombination repair system of the host cell, unless local base pairing occurs accidentally at the site of the mutation studied. When the circular single-stranded φX 174 DNA enters the host cell, it is converted by host enzymes into a double-stranded RF, which is subsequently replicated. The results show that expression of a radiation-induced mutation does not depend on replication of RF. (auth)

21540 EFFECTS OF AN R FACTOR AND CAFFEINE ON ULTRAVIOLET MUTABILITY IN SALMONELLA TYPHIMURIUM. MacPhee, D. G. (La Trobe Univ., Bundoora, Australia). Mutat. Res.; 18: No. 3, 367-370(Jun 1973).

Cells of S. typhimurium carrying the R-Utrecht factor yield significantly more uv-induced back mutants to prototrophy than do R$^-$ cells, and post-irradiation treatment of R$^+$ cells with caffeine increases the yield of back mutants still further. A method that allows the ready isolation of auxotrophic and sugar-utilization mutants from uv-irradiated cultures of S. typhimurium without any need for enrichment (e.g. by penicillin selection) is described. (auth)

21541 SPECIFICALLY uv-SENSITIVE PHOTOREACTIVABLE MUTANT OF SALMONELLA ABONY. Skavronskaya, A. G.; Andreeva, I. V.; Kiryushkina, A. A. (Inst. for Epidemiology and Microbiology, Moscow). Mutat. Res.; 18: No. 3, 259-266(Jun 1973).

A new type of uv-sensitive mutant was isolated in Salmonella abony. The uvr I2 mutation causing uv sensitivity did not affect photoreactivability of uv damage or sensitivity to γ rays, methyl methanesulfonate (MMS), mitomycin (MC), or 4-nitroquinoline I-oxide (4NQO). Mutation uvr I2 appeared to be near the uvr B gene of Salmonella: the frequencies of cotransduction of uvr B2 and uvr I2 mutations with gal were found to be 3% and 6% respectively. Close localization of the uvr I2 and uvr B2 mutations, the possibility of recombination between them and their phenotypic differences (both uvr B2 uvr I2 mutants show quantitatively different Hcr phenotypes and different sensitivities to MC and 4NQO) suggest that the uvr B2 and uvr I2 mutations might be localized in different cistrons of an operon controlling the first step of excision repair. (auth)

21542 CORRELATION BETWEEN LETHALITY AND DNA SINGLE-STRAND BREAKS IN BACILLUS SUBTILIS CELLS TREATED WITH N-METHYL-N'-NITRO-N-NITROSOGUANIDINE. Dugle, D. L.; Campbell, C. E.; Meeker, B. E.; Gillespie, C. J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Mutat. Res.; 18: No. 3, 237-245(Jun 1973).

The effects of N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) treatment on two Bacillus subtilis strains that exhibit different uv sensitivities were monitored at both the cellular (survival) and subcellular (DNA strand break) levels. The MNNG-induced single strand DNA breaks (SSB) in either strain, as measured by alkaline sucrose gradient centrifugation, were shown to be well correlated with lethality. These DNA lesions were shown by a computer simulation to be randomly induced. Cell survival after MNNG treatment is inversely related to the number of replication forks per cell which in turn depends upon the doubling time of the culture and the growth phase. The production of single-strand breaks and cell killing are proportional to the log of the initial MNNG concentration and may imply that decomposition of the mutagen is (pseudo) second order. (auth)

21543 RADIO-RESISTANT MICROCOCCUS RADIOPHILUS SP. NOV. ISOLATED FROM IRRADIATED BOMBAY DUCK (HARPODON NEHEREUS). Lewis, N. F. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 42: No. 14, 504(20 Jul 1973).

Recently, a pigmented coccus was isolated from irradiated Bombay duck (Harpodon nehereus). It is proposed to name this bacterium Micrococcus radiophilus because of its extreme resistance to radiation, and to differentiate it from M. radiodurans and other radioresistant micrococci from which it is morphologically and biochemically distinct. (ERB)

21544 IRRADIATED COBRA (NAJA HAJA PHILIPPINENSIS) VENOM. Salafranca, E. S.; Sumpaico, J. S.; Lojo, P. B. Nucleus (Diliman, Quezon City); 10: No. 5, 4-6(Dec 1972).

Cobra venom solutions used for the immunization of horses were irradiated with doses of 0.25, 0.50, and 1.0 Mrad γ radiation and the effects of irradiation on the bacterial count, toxicity, and antigenicity of the venom were studied. Samples irradiated at 1.0 Mrad had a marked reduction in the total number of bacteria and resulted in a 43% reduction in toxicity when tested in mice. Results of Oudin's test showed little destruction of antigenic components resulting from irradiation at all the doses used. Immunization tests in rabbits showed that irradiated venom toxoid gave a protective effect comparable to that of formal toxoided venom. (CH)

21545 TRANSPOSITION OF THE ARSENATE RESISTANCE LOCUS OF BACILLUS SUBTILIS STRAINS 23 AND 168. Adams, A. (New York Univ., NY). Genetics; 74: No. 2, 197-213(Jun 1973).

Wild-type Bacillus subtilis strains 23 and 168 are resistant to high concentrations of sodium arsenate. The genetic configurations of the arsenate resistance loci of these two related strains of B. subtilis were characterized. The transformable 168 strain has a single resistance locus that maps between phe and aroD in the terminal third of the genome. In contrast, strain 23 is shown to have its single arsenate resistance locus between purB and thr in the first third of the bacterial chromosome. Moreover, in strain 23 the chromosomal segment equivalent to the phe-linked asa region of 168 strains is missing. DNA isolated from 23 strains is able to transform 168 arsenate-sensitive strains to resistance and the heterologous 23 DNA is found to preferentially establish a new purB linked asa locus in such transformed cells. Thus, the majority of phenotypically arsenate-resistant cells recovered after exposure of competent 168 sensitive mutants to 23 DNA are "heterozygous" and still retain their phe-linked mutated asa locus. The tolerance of several of these heterologously transformed hybrid strains to arsenate suggests that the 168 and 23

asa gene products are similar, and a transposition model for the evolution of arsenate resistance in B. subtilis is proposed. (auth)

21546 INJECTION OF ULTRAVIOLET-DAMAGE-SPECIFIC ENZYME BY T4 BACTERIOPHAGE. Shames, R. B.; Lorkiewicz, Z. K.; Kozinski, A. W. (Univ. of Pennsylvania, Philadelphia). J. Virol.; 12: No. 1, 1-8(Jul 1973).

When uv-irradiated T4 bacteriophage (v^+) infects in the presence of chloramphenicol, the phage DNA rapidly acquires single-stranded breaks proportional to the dose of uv. In contrast, when uv-irradiated T4 v_1 (radiation sensitive mutant) infects under identical conditions, the phage DNA remains integral. A series of coinfections with v^+ and V_1 phage (uv-v_1 + majority non-uv-v^+ and uv-v^+ and majority non-uv-v_1) show that the enzyme responsible for breakage is injected by the phage. It is also demonstrated that the v_1 phage injects an inactive enzyme that delays breakage by the v^+ enzyme and interferes with subsequent repair. The cross of v^+ and v_1 phage produces mixed progeny that contain both active and inactive enzyme in a single capsid. The possible function of this breaking enzyme, necessitating injection of multiple copies, is considered. (auth)

21547 GENETIC BASIS FOR MUCOIDY AND RADIATION SENSITIVITY IN capR (lon) MUTANTS OF E. COLI K-12. Bush, J. W.; Markovitz, A. (Univ. of Chicago). Genetics; 74: No. 2, 215-225 (Jun 1973).

CapR mutants of Escherichia coli K-12 overproduce capsular polysaccharide (mucoid phenotype) and enzymes involved in capsular polysaccharide synthesis, and they are sensitive to radiation. It was uncertain whether both properties are mediated by damage to a single cistron or by a polar effect on a second cistron in the same operon. Introduction of a polarity suppressor caused no change in the overproduction of polysaccharide, in the enzymes of polysaccharide synthesis, or in radiation sensitivity of the capR mutant. Thus mucoidy and radiation sensitivity resulting from capR (lon) mutations are both the consequences of impairment of the same cistron. The experiments demonstrate the advantage of the use of polarity suppressors (over conventional nonsense suppressors) in determining whether pleiotropic effects of a mutation are the result of polarity. (auth)

21548 INDUCTION OF MITOTIC GENE CONVERSION BY X IRRADIATION OF HAPLOID SACCHAROMYCES CEREVISIAE. Campbell, D. A. (Univ. of Chicago). Genetics; 74: No. 2, 243-258(Jun 1973).

Mitotic recombination in Saccharomyces cerevisiae was examined by means of experiments in which one of the haploid parents was x-irradiated prior to zygote formation. By this method, radioinduced lesions are restricted to only one of the two non-sister chromatids that may be expected to undergo mitotic exchange in the diploid. The principal results of this work are: (1) x-irradiated haploid cells that are incapable of further vegetative growth (colony formation) are efficiently rescued into viable diploids by mating with unirradiated haploid cells; (2) x rays delivered to only one of the two haploid parents are recombinogenic in the resultant diploid. The frequency of detected recombinational events increases as a probable linear function of the x-ray dose; and (3) a majority of the induced recombinational events are nonreciprocal in nature (mitotic gene conversion). These results complement those obtained from irradiation of the vegetative diploid itself, where the induced genetic exchanges are principally reciprocal. (auth)

21549 ALLELIC COMPLEMENTATION IN THE FIRST GENE FOR HISTIDINE BIOSYNTHESIS IN SACCHAROMYCES CEREVISIAE. I. Characteristics of Mutants and Genetic Mapping of Alleles. Korch, C. T.; Snow, R. (Univ. of California, Davis). Genetics; 74: No. 2, 287-305(Jun 1973).

A number of his1 mutants were tested for suppressibility, for reversion by EMS, ICR-170, and nitrous acid, for their allelic complementation response, and for their temperature sensitivity and osmotic remediability. None of 52 mutants tested was suppressible by a known ochre suppressor. This is a very surprising result compared with other studies of suppressibility in yeast and suggests that another function essential to the cell is associated with the his1 gene product, the polarity effect of a nonsense mutation destroying the activity of the his1 enzyme and this second function. Sixty-four his1 alleles were ordered by allelic mapping methods utilizing gamma rays, x rays, and MMS. The three maps agree well in placement of alleles and were oriented on chromosome V of yeast with respect to the centromere. The 18 noncomplementing alleles are localized in the distal half of the gene, whereas the complementing alleles are distributed more or less evenly. Mutations that revert to feedback resistance map in the proximal end. Also at this end are mutations having a very high x-ray or MMS induced homoallelic reversion rate. This suggests that a number of missense mutations can occur in this region that result in innocuous amino acid substitutions in the enzyme. One x-ray map unit is estimated to correspond to about 131 base pairs or 43 amino acids, in agreement with results for the cytochrome-c protein obtained by Parker and Sherman (1969). (auth)

21550 X-IRRADIATION SCHEDULES FOR SELECTED RESPONSES IN YEAST. Spoerl, E. (Tower International Technomedical Inst., Inc., Philadelphia). T.-I.-T. J. Life Sci.; 1: No. 4, 115-121(1971).

Differences in division rate, cell number, cell size and viability are described for yeast cultures x-irradiated continuously during two or three cell generations or given short-period irradiations at a high dose-rate. These differences provide a basis for modifying irradiation procedures to obtain cell responses selected to promote the identification of affected reactions. Continuous irradiations produced uniform populations of cells that divided in synchrony when exposures were appropriately terminated, presumably because an essential reaction(s) involved in division had been selectively affected. Short-period exposures resulted in varied cell sizes as more than one population of cells developed following irradiation. (auth)

21551 COMPARISON OF THE resA1 AND polA1 MUTATIONS IN ISOGENIC STRAINS OF ESCHERICHIA COLI K-12. Glickman, B. W.; van Sluis, C. A.; van der Maas, G.; Roersch, A. (Leiden State Univ.). J. Bacteriol.; 114: No. 3, 951-955(Jun 1973).

Strains carrying either the polA1 or resA1 mutation are deficient in DNA polymerase I, and the polA1 and resA1 mutations do not complement in merozygotes. The effect of these mutations in otherwise identical genetic backgrounds was studied: after ultraviolet irradiation both strains degrade their DNA more rapidly and more extensively than the wild-type strains. However, after x-ray irradiation the resA1 strain shows little DNA breakdown and repairs its single-strand breaks. In contrast, the polA1 strain degrades its DNA extensively, and single-strand breaks are not repaired. Moreover, the resA1 strain is capable of supporting the growth of a red^- bacteriophage lambda, whereas the polA1 strain is not. (auth)

21552 HOST-MEDIATED REPAIR OF DISCONTINUITIES IN DNA FROM T4 BACTERIOPHAGE. Carlson, K.; Lorkiewicz, Z. K.; Kozinski, A. W. (Univ. of Pennsylvania, Philadelphia). J. Virol.; 12: No. 2, 310-319(Aug 1973).

Discontinuities of T4 DNA, which are caused by excision of uv-damaged areas, by decay of ^{32}P atoms, or which are present in DNA from $rII^-lig^-_{am}$ phage produced in a host nonpermissive for amber mutants are all repaired by bacterial enzymes after infection in the presence of chloramphenicol. Escherichia coli DNA polymerase I participates in the host-mediated repair, but an approximately 20-fold variation in the levels of host polynucleotide ligase does not affect either the kinetics or the extent of repair observed. On removal of chloramphenicol, host-repaired DNA from uv-irradiated phage undergoes a secondary cycle of breakage, which ultimately results in solubilization of most of the phage DNA. If the cells are co-infected with nonirradiated helper phage, the secondary breaks are repaired and the continuity of the polynucleotide chain is restored. The close coincidence in the extent of primary and secondary breakage suggests that phage-coded enzymes recognize and excise areas improperly repaired by the host. In contrast to host-mediated repair, repair mediated by rescuing phage probably restored functionality to the damaged DNA. (auth)

21553 TRANSANNULAR PEROXIDES AS RADIATION SENSITIZERS. Dougherty, T. J. (New York State Dept. of Health, Buffalo). Radiat. Res.; 55: No. 1, 101-108(Jul 1973).

A member of a potential new class of radiation sensitizers that act by radioinduced oxygen release, 9,10-di(p-carboxyphenyl)anthracene-9,10-endoperoxide, a transannular peroxide, was synthesized and evaluated in bacteria, Escherichia coli (B/r). This material acts as a sensitizer in air apparently by virtue of its high reactivity with water radicals to produce a transient but highly toxic material. In the absence of air, a small and qualitatively different effect was found, which may be due to release of oxygen either in its normal state or in an excited singlet state. (auth)

21554 X-RAY SENSITIVITY AND REPAIR CAPACITY OF A polA1 exrA STRAIN OF ESCHERICHIA COLI K-12. Youngs, D. A.; Smith, K. C. (Stanford Univ., CA). J. Bacteriol.; 114: No. 1, 121-127(Apr 1973).

A polA1 exrA strain of Escherichia coli K-12 was constructed. It was found to be more sensitive to aerobic or anoxic x irradiation than were mutants containing either polA1 or exrA alone. The ability of polA1 exrA and related strains to repair x-ray-induced single-strand breaks in deoxyribonucleic acid (DNA) was examined. The polA1 strain was deficient in type II (buffer) repair but not in

type III (growth medium-dependent) repair. The exrA strain was not deficient in type II repair but was deficient in type III repair (similar to rec strains). The double mutant polA1 exrA was deficient in both type II and type III repair. Thus, the increased x-ray sensitivity of the polA1 exrA double mutant was correlated with its decreased ability to repair x-ray-induced single-strand breaks in DNA. The hypothesis that polA rec double mutants are not viable because they lack the types II and III systems for the repair of DNA single-strand breaks was tested. Since the polA1 exrA strain is viable and is deficient in both of these repair processes, this hypothesis seems not to be correct. (auth)

21555 FATE OF TRANSFORMING DEOXYRIBONUCLEIC ACID AFTER UPTAKE BY COMPETENT BACILLUS SUBTILIS: PHENOTYPIC CHARACTERIZATION OF RADIATION-SENSITIVE RECOMBINATION DEFICIENT MUTANTS. Dubnau, D.; Davidoff-Abelson, R.; Scher, B.; Cirigliano, C. (Public Health Research Inst. of the City of New York, Inc.). J. Bacteriol.; 114: No. 1, 273-286(Apr 1973).

A collection of 16 isogenic recombination-deficient strains of Bacillus subtilis isolated on the basis of sensitivity to methyl methane sulfonate (MMS) or mitomycin C (MC) were characterized phenotypically. All were found to be somewhat sensitive to ultraviolet irradiation, MC, and MMS. The mutants were all blocked in late steps in the transformation process and were provisionally grouped into four categories on the basis of the various properties examined. Class I mutants were deficient in transformation and heterologous transduction with phage PBS1 but were transducible with homologous donors at nearly the wild-type frequency. They were blocked in donor-recipient complex (DRC) formation but formed essentially normal amounts of double-strand fragments (DSF) and single-strand fragments (SSF). The class IIa strain was deficient in transformation and PBS1 transduction, and formed DRC that was normal by all available physical and biological criteria. Class IIb mutants were deficient in transformation and PBS1 transduction, and failed to form DRC. They did produce DSF and SSF. Class III mutants were deficient in transformation, were normal in PBS1 transduction, and formed DRC that was physically indistinguishable from that of the Rec^+ parent although with slightly lowered donor-type transforming activity. Class IV strains were deficient in PBS1 transduction but were transformed at nearly the wild-type efficiency. None of the mutant strains was deficient in the adenosine triphosphate-dependent deoxyribonuclease. (auth)

21556 DEOXYRIBONUCLEIC ACID REPAIR IN A HIGHLY RADIATION-RESISTANT STRAIN OF SALMONELLA TYPHIMURIUM. Davies, R.; Sinskey, A. J.; Botstein, D. (Massachusetts Inst. of Tech., Cambridge). J. Bacteriol.; 114: No. 1, 357-366(Apr 1973).

Deoxyribonucleic acid repair was studied in gamma-irradiated wild-type Salmonella typhimurium and in a radiation-resistant derivative 20 times more resistant than wild type. After exposure to 20 or 50 krad, the wild-type strain (DB21) degraded 30 to 50% of its prelabeled DNA into acid-soluble fragments, whereas the radioresistant strain degraded less than 15% after 4 h of incubation. Post-irradiation synthesis of DNA in the wild-type strain DB21 was reduced after a dose of 20 krad and totally inhibited after exposure to 200 krad. With radiation-resistant strain, D21R6008, on the other hand, DNA synthesis was delayed after a dose of 200 krad but not inhibited. Doses of 20 and 200 krad produced a similar number of single-strand breaks in the DNA of both strains as determined by zone sedimentation analysis in alkaline sucrose gradients. The radiation-resistant strain D21R6008, on the other hand, develops strand breaks in its DNA and repairs these damages more rapidly than wild-type Salmonella. (auth)

21557 INCREASING ACTIVITY OF GERMINATING BACILLUS SUBTILIS SPORES TO INCORPORATE THYMIDINE TRIPHOSPHATE INTO DEOXYRIBONUCLEIC ACID AFTER DETERGENT TREATMENT. Fujita, Y.; Komano, T.; Tanooka, H. (Kyoto Univ.) J. Bacteriol.; 113: No. 2, 558-564(Feb 1973).

The incorporation of ^{3}H-labeled thymidine triphosphate (^{3}H-dTTP) into deoxyribonucleic acid (DNA) of germinated and then Brij 58-treated Bacillus subtilis spores was measured to study DNA replication activity of cells. The dTTP incorporation rate was very low in dormant spores, gradually increased as germination proceeded, and reached a level of the vegetative cell activity approximately 4 hr after the start of germination. This is in contrast to the DNA polymerase activity in the cell extract that remained at the same level throughout the germination period. The increase of the dTTP incorporation activity was inhibited by chloramphenicol or phenethyl alcohol. When these inhibitors were added after germination had proceeded, the elevated dTTP incorporation activity gradually decreased. Permeability to dTTP of spores germinated in the presence of chloramphenicol and then treated with Brij 58 was confirmed by (i) ^{3}H-dTTP incorporation into the treated spores following either electron or ultraviolet irradiation and (ii) release of radioactivity from the treated spores containing radioactively labeled DNA after deoxyribonuclease I treatment. (auth)

21558 INVOLVEMENT OF THE recB-recC NUCLEASE (EXONUCLEASE V) IN THE PROCESS OF X-RAY-INDUCED DEOXYRIBONUCLEIC ACID DEGRADATION IN RADIOSENSITIVE STRAINS OF ESCHERICHIA COLI K-12. Youngs, D. A.; Bernstein, I. A. (Univ. of Michigan, Ann Arbor). J. Bacteriol.; 113: No. 2, 901-906(Feb 1973).

The ras, polA, exrA, recA, and uvrD3 strains of Escherichia coli K-12 degrade their deoxyribonucleic acid more extensively than wild-type strains after x irradiation. The relationship of the recB-recC nuclease (exonuclease V) to the degradation process in these strains was determined by comparing the degradation response of the original strains with that of strains containing an additional recB21 or recC22 mutation. The initial rate of degradation in ras, polA12, exrA, and recA13 strains after an exposure of 20 to 30 kR was reduced more than 10-fold by the presence of an additional recB21 or recC22 mutation. The extent of degradation in these irradiated strains after 90 to 120 min of incubation was reduced two- to fivefold. In the uvrD3 strain, a recC22 mutation caused a fourfold decrease in initial degradation rate and reduced the extent of degradation after 90 min of incubation by a factor of 1.6. The results are consistent with the statement that the degradation process is normally dependent on exonuclease V activity. However, the observation that 10 to 30% degradation always occurred even in recB or recC strains, which lack this enzyme, suggests that alternative degradation mechanisms exist. (auth)

21559 PHOTOPROTECTION BY DIPICOLINATE AGAINST INACTIVATION OF BACTERIAL SPORES WITH ULTRAVIOLET LIGHT. Grecz, N.; Tang, T.; Frank, H. A. (Illinois Inst. of Tech., Chicago). J. Bacteriol.; 113: No. 2, 1058-1060(Feb 1973).

The resistance of three types of Bacillus cereus T spores to uv radiation corresponded to their dipicolinic acid (DPA) content. Photoprotection against uv light was observed in DPA-containing spores and in DPA-less spores irradiated through calcium dipicolinate. (auth)

21560 RELATION BETWEEN SURVIVAL AND DEOXYRIBONUCLEIC ACID REPLICATION IN ULTRAVIOLET-IRRADIATED RESISTANT AND SENSITIVE STRAINS OF ESCHERICHIA COLI B/r. Rude, J. M.; Doudney, C. O. (Albert Einstein Medical Center, Philadelphia). J. Bacteriol.; 113: No. 3, 1161-1169 (Mar 1973).

When arabinose-grown Escherichia coli B/r is ultraviolet (uv)-irradiated in the logarithmic phase of growth, the dose inactivation curve for both colony formation and deoxyribonucleic acid (DNA) synthesis (based on the relative rates of synthesis) is exponential in nature. When protein synthesis is inhibited before uv irradiation, both inactivation curves have a large shoulder. Pre-irradiation inhibition of protein synthesis increases considerably the colony-forming ability of a uv-irradiated Hcr^- and Rec^- strain of E. coli B/r. However, with the repair-deficient strains, both the shoulder and slope of the survival curve are affected. The effect of uv irradiation on DNA synthesis in Hcr^- bacteria was investigated. Pre-irradiation inhibition of protein synthesis increased uv resistance of DNA replication in this strain also. The results suggest that inhibition of protein synthesis before irradiation increases uv resistance in E. coli B/r by a mechanism that is independent of both the excision and recombination repair systems. (auth)

21561 REPAIR OF SINGLE-STRAND DEOXYRIBONUCLEIC ACID BREAKS IN ULTRAVIOLET LIGHT-IRRADIATED HAEMOPHILUS INFLUENZAE. Kantor, G. J.; Barnhart, B. J. (Wright State Univ., Dayton, OH). J. Bacteriol.; 113: No. 3, 1228-1234 (Mar 1973).

The wild-type strain and mutants of Haemophilus influenzae, sensitive or resistant to ultraviolet light (uv) as defined by colony-forming ability, were examined for their ability to perform the incision and rejoining steps of the deoxyribonucleic acid (DNA) dark repair process. Although uv-induced pyrimidine dimers are excised by the wild-type Rd and a resistant mutant BC200, the expected single-strand DNA breaks could not be detected on alkaline sucrose gradients. Repair of the gap resulting from excision must be rapid when the experimental conditions described are employed. Single-strand DNA breaks were not detected in a uv-irradiated sensitive mutant (BC100) incapable of excising pyrimidine dimers, indicating that this mutant may be defective in a dimer-recognizing endonuclease. No single-strand DNA breaks were detected in a lysogen BC100(HP1c1) irradiated with a uv dose large enough to induce phage development in 80% of the cells. (auth)

21562 INCREASED VIABILITY OF A STRAIN OF NEUROSPORA CRASSA AFTER TREATMENT WITH ULTRAVIOLET RADIATION OR OTHER AGENTS. Feldhoff, P. W.; Sullivan, J. L.; DeBusk, A. G. (Florida State Univ., Tallahassee). J. Bacteriol.; 113: No. 3, 1509-1511(Mar 1973).

A strain of Neurospora crassa with low viability but near normal germination shows a two- to sixfold increase in the number of colonies formed after treatment with uv radiation, x radiation, nitrous acid, or heat (50°C). Effective dosages of these agents produce moderate killing of the wild type. (auth)

21563 ALLELIC INTERACTION AT THE RAD 1 LOCUS IN DIPLOID CULTURES OF UV-IRRADIATED YEAST. Parry, J. M.; Parry, E. M. (University Coll. of Swansea, Eng.). Radiat. Res.; 55: No. 1, 29-40(Jul 1973).

Diploid cultures of Saccharomyces cerevisiae carrying mutant alleles of the gene rad 1 show a range of sensitivities to 254-nm ultraviolet light and vary in their responses to post-uv liquid-holding treatment. The mutant cultures containing alleles conferring the lowest sensitivity to uv are dominant to the cultures containing alleles conferring maximum sensitivity and cultures carrying such alleles all show liquid-holding recovery. In contrast, in diploids containing only alleles conferring maximum sensitivity, no changes in viability are produced by liquid-holding treatment. The results indicate that the rad 1 gene is involved in the excision repair of uv-induced pyrimidine dimers and that the integrity of the rad 1 gene is a necessary requirement for liquid-holding recovery. (auth)

21564 CHARACTERIZATION OF EXCISION REPAIR IN NEUROSPORA CRASSA. Worthy, T. E.; Epler, J. L. (Univ. of Tennessee, Knoxville). J. Bacteriol.; 115: No. 2, 498-505(Aug 1973).

The excision of pyrimidine dimers from the deoxyribonucleic acid (DNA) of Neurospora crassa was examined. Postirradiation incubation in the presence of several chemicals known to inhibit various repair systems indicated that caffeine reduced the rate of excision twofold, but did not inhibit excision completely as did proflavine and quinacrine. Examination of the time course of excision showed that repair occurs at a relatively rapid rate: approximately 60 dimers excised per min after 500 ergs/mm^2. Further evidence for rapid excision was obtained by sedimentation analysis of DNA; the maximal number of breaks introduced during repair was three, suggesting that breaks are repaired almost as fast as they are made and that only a few dimers are repaired at a time. Repair synthesis was measured by prelabeling the DNA with ^{15}N and D_2O, and then subjecting the DNA to equilibrium density gradient centrifugation after postirradiation incubation with ^{32}P. Accumulation of single-strand breaks with increasing dose of uv radiation suggested that the limiting step was subsequent to the incision and excision steps of repair. Equilibrium CsCl centrifugation demonstrated that the limiting step in excision was repair synthesis. (auth)

21565 RELATIONSHIP BETWEEN PROPHAGE INDUCTION AND TRANSFORMATION IN HAEMOPHILUS INFLUENZAE. Setlow, J. K.; Boling, M. E.; Allison, D. P.; Beattie, K. L. (Oak Ridge National Lab., TN). J. Bacteriol.; 115: No. 1, 151-161 (Jul 1973).

The interaction between transformation and prophages of HP1c1, S2, and a defective phage of Haemophilus influenzae was investigated by measurement of (i) the effect of prophage on transformation frequency and (ii) the effect of transformation on phage induction. The presence of any of the prophages does not appreciably alter transformation frequencies in various Rec$^+$ and Rec$^-$ strains. However, exposure of competent lysogens to transforming deoxyribonucleic acid (DNA) may induce phage but only in Rec$^+$ strains, which are able to integrate transforming DNA into their genome. Transformation of Rec$^+$ lysogens with DNA irradiated with ultraviolet (uv) light causes the production of even more phage than results from unirradiated DNA, but this indirect uv induction is not as effective as direct induction by uv irradiation of lysogens. Both types of uv induction are influenced by the repair capacity of the host. Wild-type cells contain a prophage and can be induced by transformation to produce a defective phage, which kills a small fraction of the cells. Defective phage in wild-type cells are also induced by H. parainfluenzae DNA, and a much larger fraction of the cells is killed. Strain BC200, which is highly transformable but is not inducible for defective phage, is not killed by H. parainfluenzae DNA, suggesting that wild-type cells are killed by this DNA because of phage induction. A minicell-producing mutant, LB11, was isolated. Some phage induction occurs in this strain when the cells are made competent, unlike the wild type. A large majority of LB11 cells surviving the competence regime are killed by exposure to transforming DNA. (auth)

21566 SUPPRESSION OF ULTRAVIOLET SENSITIVITY IN ESCHERICHIA COLI UVR502 BY THE SU58 MISSENSE SUPPRESSOR. Smirnov, G. B.; Skavronskaya, A. G. (Gamaleya Inst. for Epidemiology and Microbiology, Moscow). J. Bacteriol.; 115: No. 2, 486-489(Aug 1973).

Introduction of the su58 missense suppressor into the chromosome of the uvr502 mutant, either by mutation or by transduction, results in a marked increase of uv resistance of the uvr502 mutant. In the uvr$^+$ genetic background, the su58 suppressor causes some decrease of uv resistance and marked increase in the spontaneous mutation frequency. The presence of the su58 suppressor did not decrease the high frequency of spontaneous mutants in the population of the uvr502 strain. However, the significant increase in spontaneous mutant frequency in the uvr$^+$ su58 strain makes the difference between the uvr502 su58 and the uvr$^+$ su58 strains 18 times lower than that between the uvr502 and the uvr$^+$ suppressor-free strains. Since the missense suppressors act at the level of translation, the results suggest that the product of the uvr(502) gene is a protein. (auth)

21567 RADIATION PRESERVATION OF TISSUE-BANK CARTILAGE USING COBALT-60. Hellmich, S. (Max-Planck Institut fuer Kohlenforschung Ruhr, Ger.). Arch. Klin. Exp. Ohren-, Nasen- Kehlkopfheilk.; 202: 670-677(1972). (In German).

Experiments were performed on rabbits. Rib cartilage was irradiated with 2 Mrad ^{60}Co radiation. The cartilage was then implanted subcutaneously either into the same or another animal. The implant was treated like a dead foreign body and caused no typical cell reaction. Irradiation did not significantly change the bio-mechanical properties of the cartilage. While transplants into the same animal retained their volume throughout 12 months, transplants into another animal showed a shrinkage of 20 to 36%. (HBG)

21568 INSTALLATION FOR DISINFECTION OF CLOSED RADIOACTIVE SOURCES. Bogoudinov, R. D.; Lavrent'ev, A. I.; Dmokhovskii, V. V.; Volkova, M. A.; Falileeva, E. P. (Scientific-Research Roentgeno-Radiological Inst., Moscow). Med. Radiol.; 18: No. 8, 52-55(Aug 1973). (In Russian).

An installation for disinfection of closed radioactive sources in various metal and plastic containers by the method of hot and cold disinfection is discussed. The results of clinical tests showed that the given installation was a step forward in the elaboration of protection equipment, met the requirements of the personnel protection, and rather fully corresponded to its functional designation on the level of the best modern models. (auth)

21569 EAST COAST FEVER OF CATTLE: ^{60}Co IRRADIATION OF INFECTIVE PARTICLES OF THEILERIA PARVA. Cunningham, M. P.; Brown, C. G. D.; Burridge, M. J.; Musoke, A. J.; Purnell, R. E.; Dargie, J. D. (East African Veterinary Research Organization, Kubete, Kenya). J. Protozool.; 20: No. 2, 298-300 (1973).

Infective particles (IPs) of Theileria parva, the causative organism of East Coast Fever of cattle, were harvested from the tick vector, Rhipicephalus appendiculatus, using an in vitro feeding technic. In a ranging experiment, pairs of cattle were inoculated with aliquots of suspensions of IPs irradiated at doses of 4 to 137.6 krad. Doses of irradiation in excess of 8 krad appeared to destroy the parasite. In the 2nd and 3rd experiments, groups of 5 cattle were inoculated with aliquots of suspensions containing low and high concentrations of IPs respectively, irradiated at doses of 4 to 32 krad. In the 2nd experiment, doses of irradiation in excess of 10 krad appeared to destroy the parasite. In the 3rd experiment, at least 1 animal became infected when inoculated with an aliquot of a suspension irradiated at 16 krad. In all experiments, it appeared that increasing doses of irradiation destroyed increasing numbers of IPs. There was no conclusive evidence that IPs which survived irradiation were attenuated, and it appears that vaccination of cattle against ECF is unlikely to be achieved by inoculation of irradiated IPs using the methods described. (auth)

21570 STUDIES ON THE INDUCIBLE INHIBITOR OF RADIATION-INDUCED DNA DEGRADATION OF ESCHERICHIA COLI. Pollard, E. C.; Randall, E. P. (Pennsylvania State Univ., University Park). Radiat. Res.; 55: No. 2, 265-279(Aug 1973).

The presence of an inducible inhibitor of postirradiation DNA degradation was shown in several strains of E. coli. The time course of induction was followed by adding rifampin at various times after induction by ultraviolet light. The dose dependence of induction was observed for both uv and ionizing radiation and parallels that for the induction of phage λ. Using rifampin, the presence of some concomitant DNA synthesis in a cell that is degrading DNA was shown. The experiments suggest that DNA synthesized after irradiation is not degraded. The induction of the inhibitor is an all-or-nothing process, and a culture of cells that has been induced and then irradiated shows no degradation in most cells and full degradation in the remainder. Cells with the inducible inhibitor show a variation in the survival of colony-form-

ing ability in rich versus lean medium; cells lacking the inhibitor do not show the effect. It is suggested that this is related to the rescue of one or more genomes by the action of the inhibitor. (auth)

21571 REPAIR OF DNA SINGLE-STRAND BREAKS IN E. COLI K-12 X-IRRADIATED IN THE PRESENCE OR ABSENCE OF OXYGEN: THE INFLUENCE OF REPAIR ON CELL SURVIVAL. Town, C. D.; Smith, K. C.; Kaplan, H. S. (Stanford Univ., CA). Radiat. Res.; 55: No. 2, 334-345(Aug 1973).

The repair of DNA single-strand breaks was studied in Escherichia coli K-12 (W3110) after x irradiation in the presence and absence of oxygen. On completion in buffer of a very fast repair process (Type I) there are three times as many breaks remaining after irradiation in the presence as compared with the absence of oxygen. These breaks are then rapidly repaired in buffer by the Type II system; a process that is deficient in strains carrying the polA1 mutation (an amber mutation in the structural gene for DNA polymerase I). After low doses of x rays, the Type II system can repair all of the breaks presented to it. Beyond a threshold dose it repairs a constant proportion (~90%) of the breaks presented to it whether or not oxygen is present during irradiation. Consistent with the apparent insensitivity of the Type II repair process to the presence of oxygen during irradiation, otherwise isogenic pol^+ and pol^- derivatives were found to have the same oxygen enhancement ratio (OER) for cell survival. After Type II repair is complete, some of the remaining breaks can be repaired by the growth-medium-dependent Type III system. This process can repair only about 2 additional breaks per single-strand genome in this strain, whether irradiation is in the presence or absence of oxygen. Thus, as far as the repair of DNA single-strand breaks is concerned, neither the Type II nor the Type III repair system shows any specificity for breaks produced in the presence or absence of oxygen. OER values were determined for the recA and recB mutants, which are deficient in Type III repair. While the recB derivative showed only a slight reduction in OER, the recA derivative had an OER of about 2.0 compared with about 3.4 for the rec^+ parental strain. Since the recA mutation would affect Type III repair to the same extent whether the cells were x-irradiated in the presence or absence of oxygen, the reduced OER for the recA strain probably reflects the additional involvement of the recA gene product in the repair of some other lesion, possibly based damage, that is affected by the presence of oxygen during irradiation. (auth)

21572 MODIFICATION OF DNA REPAIR AND SURVIVAL OF X IRRADIATED POL, REC, AND EXR MUTANTS OF ESCHERICHIA COLI K-12 BY 2,4-DINITROPHENOL. Van Der Scheueren, E.; Smith, K. C.; Kaplan, H. S. (Stanford Univ., CA). Radiat. Res.; 55: No. 2, 346-355(Aug 1973).

2,4-Dinitrophenol (DNP) (3×10^{-3} M), when added to growth medium for 90 min of postirradiation incubation, markedly potentiated the x-ray induced killing of E. coli K-12 wild-type, polA1 and uvrB5 cells. The recA13, recB21, and exrA mutants, which are deficient in the slow, growth-medium dependent (Type III) repair of x-ray-induced DNA single-strand breaks, did not show radiation sensitization by DNP. In the polA1 background, DNP treatment was as effective as an exrA mutation in sensitizing polA1 cells to killing by x rays. Alkaline sucrose gradient studies showed that DNP inhibited the Type III repair of single-strand breaks. This inhibition was largely irreversible. (auth)

21573 UV SENSITIVITY OF SEVERAL GENETIC MARKERS OF HAEMOPHILUS INFLUENZAE DNA. Chevallier, M. R.; Greth, M. L. (Institut de Botanique, Strasbourg). Genetics; 74: No. 3, 405-420(Jul 1973).

Studies on inactivation by uv of several genetic markers of the streptomycin and novobiocin resistance regions of H. influenzae DNA showed that two kinds of markers may be found with respect to frequency of integration, uv sensitivity, and reactivability. One class of markers has high integration frequency and low uv sensitivity, which can be partly explained by the reactivability of the irradiated markers. The second class of markers has low integration frequency and high uv sensitivity. Markers of each class was found in the novobiocin region. In one recipient strain with decreased transformability the difference in integration frequency between the two classes is enhanced. (auth)

21574 RADIOPROTECTION OF ENZYME AND BACTERIAL SYSTEM BY DITHIOTHREITOL. Redpath, J. L. (Mount Vernon Hospital, Middlesex, Eng.). Radiat. Res.; 55: No. 1, 109-117 (Jul 1973).

The radioprotection of dilute aqueous solutions of the enzyme papain, and of suspensions of Serratia marcescens by the sulfhydryl compound, dithiothreitol, was demonstrated. The results are considered in terms of the stability of this compound to air oxidation and its free radical reactivity. It has been shown that radical reactivity. It has been shown that radical scavenging and radical repair processes are the major causes of the observed radioprotective effect. The effect of medium and of the saturating gas on the radioprotective action of dithiothreitol toward Serratia marcescens is discussed. (auth)

21575 GENETIC STUDIES ON THE ACTIONS OF RADIATION AND ANTI-CANCER DRUGS ON E. COLI STRAIN C. Nishiki, T. (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 9, 744-759(Dec 1972). (In Japanese).

To compare the effects of radiation with that of anti-cancer drugs on bacterial cells, experiments were carried out, mainly with Escherichia coli strain C-436, especially on the lethal effect of radiation and anti-cancer drugs, isolation of mutants, and their genetic analysis. Escherichia coli strain C-436 was as resistant against uv light and x rays as E. coli strain K-12. Mitomycin-C revealed a marked lethal effect, whereas the effect of cyclophosphamide was weak. Ultraviolet light and mitomycin-C acted as powerful mutagenic agents, whereas the mutagenic effect of cyclophosphamide was weak. A larger number of arginine prototrophic mutants were obtained than histidine prototrophic mutants, and tryptophane prototrophic mutant could not be obtained. Further, the comparative investigation was done on the yellow color forming ability and the alteration of genetic characters derived from E. coli strain C-436 after uv irradiation or the anti-cancer drug treatment. The results indicated that the arginine prototrophic mutants with yellow color forming ability amounted to 98.8% (97.6 to 100%), and the histidine prototrophic mutants with the same ability remained at 14.7% (0 to 33.3%). With regard to the relation between the arginine requirement and the yellow color formation of E. coli strain C, the progeny analysis of their recombinants derived from the conjugation experiment between strain C-167 (Hfr-7) and strain C-9 suggested that the determinant of color formation is related genetically to the arginine locus rather than the tryptophane locus. That is, the alteration from Arg^- to Arg^+ is accompanied with the yellow colony. The yellow color determinant of E. coli strain C, therefore, was revealed to be linked to the arginine locus. (auth)

21576 CHANGE OF MEMBRANE STRUCTURE AFTER IRRADIATION WITH IONIZING RADIATIONS. Rink, H. (Univ., Bonn). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

Irradiated cells very frequently show significant changes in transport rates and the shift of substances from the cell to its environment. An analysis of these radiation effects poses certain difficulties as they are dependent on the energy metabolism and the function of the membranes. A linear relationship was found between the oxygen consumption and the K^+ content in yeast cells of different K^+ concentration that were offered three different substrates (acetate, acetaldehyde, ethanol), all three being decomposed via K^+-dependent enzyme reactions. The degree of correlation between the two parameters was found to be specifically determined by the substrate and to remain unaffected by irradiation (200 kR). The conclusions to be drawn from this finding are discussed. Although radioinduced changes in the functioning of the membrane have often been discussed in the literature, experimental evidence for such changes could be provided only rarely up to now. One example is the radioinduced changes in membrane-dependent SH groups that are correlated with the decrease in K^+ concentration. Another example confirming radiation-induced changes in the membrane structure was provided by experiments on the adsorption of Ca^+ ions on the cell surface and their suppression by Mg^{2+}, UO_2^{2+}, and H^+ ions, or their desorption by EDTA and ATP, respectively. (GE)

21577 COOKED FLAVOR OF GAMMA-IRRADIATED RICE. Namiki, K. (Sugiyama Women's Senior Coll., Nagoya, Japan); Kurahashi, K.; Kawakishi, S. Shokuhin Shosha; 6: No. 1, 1-10 (Jun 1971). (In Japanese).

The unpolished rice samples (Koshihikari) were packed in polyethylene bags and exposed to γ rays of ^{60}Co with the doses from 10 to 5000 Krads. These samples were then polished and cooked with water 3:4 in weight. Sampling of the head space gas by microsyringe was done at 30 min after the cooking, and gas-liquid chromatography (GLC) analysis was made by the Shimazu gas chromatograph GC-4 equipped with FID and a glass column of Carbowax 20M. The head space gas of unirradiated rice gas about 22 peaks in the gas chromatogram, and most of the main peaks were identified by comparing their retention times with those of the authentic carbonyl compounds and their 2,4-dinitrophenol (DNP) derivatives, and in addition by the pretreatment of the head gas with the C. P. resin (selectively adsorbing resin for carbonyl compound) to remove carbonyl components of the gas. The increase in the volatile components became remarkable

especially with the doses of 2000 Krads or above and in the low boiling fractions such as propionaldehyde, n-butylaldehyde, n-valeraldehyde, methyl iso-propyl ketone, and n-caproaldehyde. The increase of these carbonyl compounds may be attributed to direct effect of radiation on amino acids or fatty acids and/or to enhanced strecker degradation of amino acids with increased amount of carbonyl compounds by irradiation. (auth)

21578 NUCLEIC ACID CONTENTS IN SOME SPECIES OF AMOEBAE DIFFERING IN THEIR RADIOSENSITIVITY. Korogodina, Yu. V.; Sokurova, E. N.; Kharlamova, L. A.; Khaustov, V. I. (Inst. of Medical Radiology, Obninsk, USSR). Tsitologiya; 15: No. 5, 613-616(May 1973). (In Russian).

The content of nucleic acids was determined in cells of different species and strains of amoebae: Amoeba proteus, strains B and C, Entamoeba moshkovskii, and E. invadens. The components of nucleic acids were determined in cell hydrolysates. In cells of Entamoeba species that are more radioresistant, DNA and RNA contents were sufficiently lower as compared to that of cells of less resistant strains of A. proteus. No significant differences in this respect were found between the two strains of A. proteus, although these differ markedly in their radiosensitivity. (auth)

21579 EFFECT OF RADIATION ON THE GROWTH BEHAVIOUR OF COLLETOTRICHUM FALCATUM WENT. Shahjahan, A. K. M.; Ahmed, H. U. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 54-56(Apr 1972).

The fungus Colletotrichum falcatum Went was subjected to irradiation from a ^{60}Co gamma source with the doses of 0, 25, 50, 75, 100, and 125 kR. The fungus grew and sporulated well on all doses with slight variation. No marked difference in the morphology and colony characters of the fungus was observed up to the dose of 125 kR. (auth)

21580 ROLE OF THE METABOLIC EFFECTS OF CYSTEINE IN THE ENHANCEMENT OF CELLULAR RADIORESISTANCE. I. Effects on E. Coli Cells. Hernadi, F. (Debrecen Univ. of Medicine, Hungary). Izotoptechnika; 16: No. 6, 336-345(Jun 1973). (In Hungarian).

Cysteine has caused several changes in the metabolism of strains of E. coli. These changes are very likely to be connected with its metabolic radioresistance effect. (auth)

21581 ULTRAVIOLET IRRADIATION OF POTATO VIRUS X, ITS RNA, AND A HYBRID VIRUS PARTICLE: PHOTOREACTIVATION, KINETIC ISOTOPE EFFECTS, AND QUANTUM YIELD OF INACTIVATION. McCleary, L. O.; Gordon, M. P. (Univ. of Washington, Seattle). Photochem. Photobiol.; 18: No. 1, 9-15 (Jul 1973).

Studies were made of the inactivation of potato virus X (PVX), free PVX-RNA, and a phenotypically mixed virus particle composed of PVX-RNA and tobacco mosaic virus (U-1 strain) protein (PVX_{RNA}:TMV_{PRO}) by uv radiation of 254, 280, and 302 nm wavelengths. Rate constants and quantum yields of inactivation were determined under conditions of photoreactivation and nonphotoreactivation in H_2O and D_2O. The ratios of the rate constants in H_2O to those in D_2O obtained for PVX-RNA were greater than unity at the above three wavelengths, as was the case for PVX at 254 and 302 nm. The ratios of the rate constants were, within experimental error, equal to unity for PVX_{RNA}:TMV_{PRO} at all three wavelengths and for PVX at 280 nm. It is concluded that, in contrast to the situation observed with TMV and PVX_{RNA}:TMV_{PRO}, the behavior of the intact PVX viron upon irradiation closely approximates the behavior of free RNA in solution, on the basis of quantum yields of inactivation, photoreactivated sector, and the ratio of kinetic isotope effects in H_2O and D_2O. (auth)

21582 SYNERGISTIC ACTION OF ULTRAVIOLET AND X IRRADIATION ON MUTANTS OF ESCHERICHIA COLI K-12. Martignoni, K. D.; Smith, K. C. (Stanford Univ., CA). Photochem. Photobiol.; 18: No. 1, 1-18(Jul 1973).

Prior uv irradiation increased the x-ray sensitivity of wild-type E. coli K-12. This synergistic effect of combined uv and x irradiation was also observed, but to a reduced extent, in uvrA, uvrB, uvrC, and polA mutants, but was absent in exrA, recA, recB, or recC mutants of E. coli K-12. Alkaline sucrose gradient studies demonstrated that the rec and exr gene-controlled, growth-medium-dependent (Type III) repair of x-ray-induced DNA single-strand breaks was inhibited by prior uv irradiation. This inhibition probably explains the synergistic effect of these two radiations on survival. (auth)

21583 EFFECT OF A HISTIDINE OPERATOR, CONSTITUTIVE MUTATION ON UV-INDUCED MUTABILITY WITHIN THE HISTIDINE OPERON OF SALMONELLA TYPHIMURIUM. Savic, D. J.; Kanazir, D. T. (Boris Kidric Inst. of Nuclear Science, Belgrade). Mol. Gen. Genet.; 118: No. 1, 45-50(1972).

The presence of the histidine operator-constitutive mutation his01242 increased uv-induced mutability within the histidine operon of Salmonella typhimurium. The rate of reversion of hisC and hisF ochre and frameshift mutants increased 5- to 3-fold when these mutations were coupled with his01242, which caused 15-fold derepression of the operon. The effect did not extend to the whole chromosome since the rate of uv-induced mutability at the unlinked streptomycin locus was the same in the strains carrying $his0^+$ or his01242 alleles. The same phenomenon was observed in Hcr^- strains. (auth)

21584 ULTRAVIOLET INACTIVATION OF MURINE LEUKEMIA VIRUS AND ITS ASSAY IN PERMISSIVE AND NON-PERMISSIVE CELLS. Yoshikura, H. (Tokyo Univ.). Int. J. Cancer; 11: 739-746(1973).

The different titration patterns of murine leukemia viruses (MuLV) in permissive and non-permissive cells were confirmed; the titration kinetics was one-hit in the permissive host and two-hit in the restrictive host. The following phenomena were also observed: uv-inactivation curves were nearly the same, regardless of whether the virus was titrated in permissive or restrictive cells; infection by MuLV of its restrictive host was enhanced by the uv-inactivated homologous MuLV; uv-inactivated NB-tropic virus propagated in N-type cells enhanced plaque formation of N-tropic virus in B-type cells and not that of B-tropic virus in N-type cells. UV-inactivated NB-tropic virus propagated in B-type cells enhanced plaque formation of B-tropic virus in N-type cells, but not that of N-tropic virus in B-type cells. (DE)

21585 MICROBIOLOGICAL PROBLEMS IN FOOD IRRADIATION: RADIOSENSITIVITY, INDUCED RADIORESISTANCE, AND RADIOSENSITIZATION. Faizur Rahman, A. T. M.; Siddiqui, A. K.; Amin, R. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 66-76(Apr 1972).

Different food spoilage microorganisms including the viruses have a widely varying degree of radioresistance, some of them requiring doses in the range of several hundred kilorads for one tenth reduction in population. The high dose requirement for the preservation of some food causes undesirable changes, losses in the nutritive values, and organoleptic qualities of these food items. Efforts were made to reduce the radiation dose requirement by rendering the cells more sensitive to radiation destruction by pre or post irradiation thermal treatment or by irradiation in presence of certain chemicals. These methods of attaining radiosensitization of microbes and their possible application in actual food processing are discussed. The problem of acquiring radioresistance by microbes on successive irradiation and its practical significance is also discussed. (auth)

21586 SECONDARY EFFECTS OF STERILIZATION OF THE RIFAMPICIN BY GAMMA IRRADIATION. Crippa, P. R.; Tedeschi, R.; Vecli, A. (Univ., Parma, Italy). Farmaco (Pavia) Ed. Prat.; 28: No. 4, 226-232(Apr 1973).

The effects of gamma radiation at sterilizing doses on rifampicin were studied by several physical and chemical techniques. In particular the ESR results suggest a negligible effect and confirm the possibility of using this type of treatment for sterilizing rifampicin. (auth)

21587 FOOD IRRADIATION. Revetti, L. M. (Instituto Venezalano de Investigaciones Cientificas, Caracas). Acta Cient. Venez., Supl.; 22: No. 3, 234-238(1972). (In Spanish).

The feasibility of extending shelf-life of vegetables cultivated at Venezuelan environmental conditions, was proved. Working with Solanum tuberosum and Allium cepa, best results were obtained at 10 Krad and 4 Krad respectively. On irradiating Zea mayz, an increase on the fat acidity of the control group was remarkable on comparison to the irradiated groups. There was no change of the insaturation values, that is, the fat quality was not changed. Some tropical fruits have been considered for irradiation. Prior to irradiation, work has been done on identifying different components. (auth)

21588 BIOLOGICAL EFFECT OF HIGH-ENERGY BREMSSTRAHLUNG ON E. COLI BACTERIA. Zywietz, F. Hamburg; Univ., Hamburg (1971). 66p. (In German).

Thesis.

The irradiation arrangement, the beam characteristics, and the dosimetric experiments are described. The dependence of the G-value on the photon energy is discussed. The depth-dose distribution as a function of the formation of the electromagnetic cascade was measured in a water phantom. The cascade factor and the position of the maximum dose were found to depend on the energy applied. The relation between dose and quantum flux can be used to calculate the energy dose at any depth in the phantom, taking into account the cascade factor. The second part gives the details of the radiobiological experiments for the study of the inactivation of bacteria, the formation of auxotrophic mutants, and the rate of reverse mutation to the wild type. The dose-effect curves obtained for the inactivation and reverse mutation show a lower biological

effectiveness of the high-energy bremsstrahlung. A RBE of 0.74 was determined for the inactivation and for the radioinduced reverse mutations a RBE of 0.72. The radioinduced auxotrophic mutants observed both after 7.2-GeV irradiation and after 200 keV irradiation were found to be dose-dependent. The rate of deficient mutants induced by high-energy bremsstrahlung is shown to be lower than that induced by irradiation, but no RBE could be determined. The spectrum of mutants induced by GeV irradiation is somewhat more differentiated and includes mutants that could not be found after x irradiation. This shows that the damaging effect of GeV irradiation on the DNA of the bacteria is less than that of x irradiation and that there is a difference in quality between the two types of radiation with regard to the mutation spectra. The investigations in various depths of the water phantom revealed that the RBE first changes with depth but then remains constant. The values obtained are compared to RBE values determined for other irradiation subjects such as seeds and seedlings of Vicia faba and mice. (GE)

21589 EVIDENCE IN FAVOR OF MULTIPLE MANIFESTATION OF X-MUTATION IN T4D PHAGE. Vinetskii, Yu. P.; Azizbekyan, R. R. (Inst. of General Genetics, Moscow). Genetika; 9: No. 6, 121-125(Jun 1973). (In Russian).

It is shown that the original T4x mutant (Harm) has ts-mutation in rIIA gene. Whether the increased uv-sensitivity, the decreased phage yield, and the decreased frequency of genetic recombination are due to the X-mutation was studied. The data obtained indicate that the X-mutation has a pleiotropic effect. (auth)

21590 INACTIVATION OF PURIFIED DNA OF LAMBDA BACTERIOPHAGE WITH UV AND GAMMA RAYS. Effect of the Repair System of Host Cells. Bresler, S. E.; Kalinin, V. L.; Shelegedin, V. N. (Inst. of Nuclear Physics, Leningrad). Genetika; 9: No. 6, 111-120(Jun 1973). (In Russian).

The repair of lethal damages induced in vitro in purified DNA of $\lambda_{11}C$ bacteriophage under the action of uv and γ rays of ^{137}Cs (direct and indirect effects) was investigated. The biological activity of λ DNA was measured by means of calcium-dependent transfection of various Escherichia coli strains. The efficiency of uv-lesion repair decreases 4 to 5 times when the recipient cells bear uvrA6, uvrB5, or uvrC38 mutations and 2 times when the recipient cells bear polA1 mutation. The rec mutations affect the host cell repair of uv-lesions to a small degree. On the other hand, uvr and rec mutations do not affect the host cell repair of gamma-lesions, but polA1 mutation decreases gamma resistance of isolated λ DNA. Apparently the calcium-dependent method of transfection does not alter the bacterial rec and uvr functions. (auth)

21591 VARIANTS OF ASPERGILLUS NIGER INDUCED BY GAMMA RAYS. Hannan, M. A. (Atomic Energy Centre, Dacca, Bangladesh). Indian J. Exp. Biol.; 10: No. 5, 379-381(Sep 1972).

A broad spectrum of variants resulted in A. niger by treatment with different doses (20, 40, 60, and 80 kR) of gamma rays. The variants showed a great deal of differences in growth characteristics, and morphological and biochemical properties. The number of aconidial, sparse-conidial, and especially the yellow type variants increased with the increasing doses of radiation. A dwarf strain (numbered 6) showed 2 to 3 fold increase in the yield of citric acid over the parent. Gamma-irradiation temporarily inhibited the sporulation in some survivors of A. niger and such an effect increased with the increasing doses. Accumulation of some kind of yellow pigment was observed in the colonies surviving higher doses and it is suggested to be due to disturbances in certain metabolic processes that are sensitive to radiation. (auth)

21592 APPLICATION OF IONIZING RADIATION IN VEGETABLE AND FRUIT PRESERVATION. Salkova, Z. Bull. Slov. Pol'nohospod. Akad., Vysk. Ustavu Potravin.; 11: No. 1, 10-15 (1972). (In Slovak).

The effect is explained of ionizing radiation on extending the storage time of food, mainly fruit and vegetables. Experience gained in certain countries from the preservation of fruit and potatoes using gamma radiation is briefly outlined and results of experimental irradiation of strawberries and potatoes are presented. Potatoes were irradiated with ^{60}Co γ radiation at doses of 7.5 and 10 krad, strawberries were irradiated with doses of 200 and 300 krad. The irradiation was found to result in only insignificant variations in the sugar and the vitamin C contents. The results are tabulated. (INIS)

21593 INFLUENCE OF METHODS OF PRESERVATION ON THE QUALITY OF MEAT AND MEAT PRODUCTS. A Survey of the Literature With Special Reference to the Chemical and Physical Aspects. Hofmann, K. (Inst. fuer Chemie und Physik, Kulmbach, Ger.). Fleischwirtschaft; 52: No. 11, 1403-1415(1972). (In German).

The influence of the various physical and chemical methods of preserving meat and meat products, e.g., heating, freezing, freeze-drying, heat-drying, irradiation, salting, curing, and smoking, on the quality of these products (particularly as regards flavor, odor, tenderness, juiciness, and keeping quality) is illustrated and discussed by reference to the more recent literature. Freezing is the most gentle method of preservation from all points of view. Rapid freezing and storage temperatures below –15°C make it possible, for example, for packaged pork to have a storage life of about nine months. Irradiation of meat is of little importance to us for the time being, since its use is forbidden in the German Federal Republic. One of its disadvantages is the development of off smells and flavors (known as irradiation aroma). One of the possible methods for preventing such off flavors is the inactivation of enzymes by means of blanching prior to irradiation. (GE)

Radiation Effects on Plants

Refer also to abstracts 21501 and 21504.

21594 (IAEA-R-378-F) MAXIMIZATION OF THE FREQUENCY AND SPECTRUM OF INDUCED MUTATIONS IN RICE AND PROMOTION OF CROSSING-OVER IN INDICA x JAPONICA CROSSES. Part of a Coordinated Programme of Research on the Use of Induced Mutations for Rice Improvement. Final Report, 1 December 1965–30 November 1970. Swaminathan, M. S. (International Atomic Energy Agency, Vienna (Austria)). Apr 1971. 40p. INIS.

Mutation research in rice was initiated at the Indian Agricultural Research Institute in 1975. Various problems such as mutagen treatment techniques, radiosensitivity, relative efficiency and effectiveness of various physical and chemical mutagens were studied. The frequency and spectrum of mutations could be enhanced by treating dehulled rice seeds with mutagens and also by treating the seeds with mutagens at certain pressure levels. The relative mutation sensitivity differed between variety groups, the indica varieties were more resistant than japonica and javanica varieties. Mutation frequency showed an exponential increase with increased M_1 survival following treatment with both physical and chemical mutagens. The mutation spectrum in general was wider following chemical treatments than following gamma treatments. An enhancement of crossover frequency was possible in indica x japonica crosses by mutagen treatments. A number of mutants possessing the indica grain type without altering the other characteristics were obtained from the japonica type variety Taichung 65. Most of indica grain mutants with japonica plant type showed enhanced resistance to bacterial leaf blight disease as compared with Tainan 3. The induced indica grain mutants of Taichung 65 had a protein content ranging from 9.1 to 11.2% compared with the control value of 8.7%. (INIS)

21595 (IAEA-R-547-F) BREEDING OF EARLY, HIGH YIELDING, LODGING, AND DISEASE RESISTANT RICE VARIETIES WITH INDUCED MUTATIONS. Part of a Coordinated Programme on the Use of Induced Mutations for Rice Improvement. Final Report, 15 September 1967–14 October 1972. Ree, J. H. (International Atomic Energy Agency, Vienna (Austria)). Nov 1971. 26p. INIS.

In 1966 seeds of the leading rice variety, Palkwang (japonica type), were irradiated with x rays and thermal neutrons at the Institute of Atomic Energy in Seoul. The mutagen-treated rice was grown for selection of mutants of economic importance. A short culm and lodging resistant mutant variety named MILYANG #10 was selected. The yield was about the same as its mother variety at the nitrogen level of 80 and 120 kg per hectare. It yielded 1.2% higher when heavy nitrogen fertilizer at 150 kg/ha was applied. Protein content of MILYANG #10 was slightly increased but lysine content was slightly decreased when the amount of nitrogen fertilizer was increased up to 180 kg/ha. The mutant line MR 515-17 bred true for resistance to leaf blast disease and the most resistant among all lines tested. However; its culm length and yielding capacity should be further improved. It is suggested from the data that the induced mutations can increase the genetic variability in rice and mutants of economic importance such as short-culm, resistant to lodging, resistant to blast disease and highly responsive to nitrogen fertilizer could be developed. (INIS)

21596 (IAEA-R-548-F) MUTABILITY OF POLYGENES AND THE UTILIZATION OF INDUCED GENETIC VARIABILITY. Part of a Coordinated Programme of Research on the Production and Use of Induced Mutations in Plant Breeding. Final Report, 1 November 1967–31 May 1970. Scossiroli, R. E. (International Atomic Energy Agency, Vienna (Austria)). Jan 1972. 13p. INIS.

Two wheat cultivars were used in the study: Triticum durum cv. Capelli and Triticum aestivum cv. Damiano. 10,000 R x rays were

applied to dry seeds in a single acute dose at the beginning of the experiments. Plants were grown under field conditions, seeds for subsequent generations were obtained under controlled self-fertilization. The analysis of data collected at the fifth generation after irradiation (R_5) was performed under a combined hierarchic and factorial scheme of analysis of variance, using a specially designed program for the IBM 7094 computer. The data suggest that: the original material of cv. Capelli was genetically very homogeneous, whereas cv. Damiano was heterogeneous. The radiation treatment has been able to induce differentiation between lines. The radiation treatment was able to induce genetic variability within each line for all traits under consideration. The induced variability was apparently of the additive type as can be judged from the behavior of variances of the subgroups classification under controlled inbreeding with pedigree and also from the results of artificial selection experiments. (INIS)

21597 (INIS-mf-337) IRRADIATION EFFECTS ON RICE AND WHEAT. Massa, M. H. L. M.; Fagundes, C. C. L.; da Cruz, M. H. L. (Comissao Nacional de Energia Nuclear de Brazil, Rio de Janeiro). Dec 1971. 28p. (In Portuguese). INIS.

Irradiation effects on rice and wheat were studied by the food preservation program of the Brazilian Nuclear Energy Commision. Analyses of rice irradiated at 28 krad did not show important alterations. Wheat irradiated at several radiation doses up to 4 Mrad showed an increase in amide oxidation, directly proportional to the dose. (INIS)

21598 (UCB-34-P-23-X-5) BEHAVIOR AND EFFECTS OF RADIONUCLIDES IN SOILS AND PLANTS. Babcock, K. L.; Handley, R.; Schulz, R. K. (California Univ., Berkeley. Dept. of Soils and Plant Nutrition). Jul 1973. Contract AT(04-3)-34. 92p. Dep. NTIS $6.75.

Results are reported from studies on: the effects of Ca and K on root uptake and tissue distribution of ^{85}Sr in maize; the effects of Ca, K, and temperature on the uptake of carrier-free ^{137}Cs by intact tomato leaves; and field experiments on the effects of β radiation from ^{90}Y fallout simulant on the crop yields of peas, bush beams, and black eye peas. The fallout simulant was applied to mature plants at a dose of 55 mCi/m^2, resulting in a surface dose of 1690 rads in the region of shoot meristems. This level of radiation reduced the crop yield of peas by 39% of the controls and the crop yield of bush beans and black eye peas by lesser amounts. The effects of artificial dew on retention of the fallout simulant on the leaves; resulting in an increased radiation dose, was studied on bush beans and black eye peas. The radiation dose of the moistened foliage was considerably higher than that of dry foliage. A dose of about 400 rads to shoot meristems severely affected crop yield. Damage to meristem was greater than that of mature leaves. Theoretical calculations led to the conclusion that the β-component in fallout is more significant than the γ-component for adversely affecting crop yield. (CH)

21599 MODERATE MUTANTS OF AMOEBOPHELIDIUM PROTOCOCCARUM, AN INTRACELLULAR PARASITE OF PROTOCOCCALES. Gromov, B. V.; Titova, N. N. (Leningrad State Univ.). Genetika; 9: No. 5, 171-173(May 1973). (In Russian).

Mutants of Amoebophelidium protococcarum forming small plaques on the host alga were obtained after uv-irradiation. The study of such a mutant showed that it was moderate and in liquid algal cultures destroyed a smaller proportion of host cells as compared to the wild type. (auth)

21600 ANALYSIS OF CLONAL SURVIVAL CURVES OBTAINED ON γ-IRRADIATED CHLORELLA CELLS AT SEVERAL DOSE RATES. Gilet, R.; Santier, S. (CEN, Grenoble, France). Biophysik; 9: No. 4, 335-348(1973). (In French).

Survival curves were obtained after split or single doses at high or low dose rates. The living material was Chlorella cells in G_0 stage (non-dividing cells). It is possible to explain these curves by the effects of three types of damage: directly lethal damage, repairable sublethal damage, and non-repairable sublethal damage. (auth)

21601 GENETIC EFFECTS IN TOMATO PRODUCED BY ALPHA IRRADIATION OF POLLEN. Scarascia Venezian, M. E. (Instituto Sperimentale per la Cerealicoltura, Rome). Genet. Agr.; 27: No. 1, 75-91(30 Mar 1973). (In Italian).

In the M_2 generation, after treatment of tomato pollen with alpha particles, the more frequently observed mutation was the wiry which resulted in severe morphological, physiological and biochemical damage. From the statistical analysis of some quantitative characters (yield and number of fruits, flowering time, and mean maturity period) in M_3 and M_4 generations derived from normal appearing plants it was detected that the mean values of irradiated and control progenies show no significant difference and that genetic variability increases only for some cases; moreover, some new plus and minus variants of some practical interest appeared. According to reduced setting, poor number of seeds and their low germinability, and reduced survival of plants in M_1 and M_2 generations, it is possible to consider the mutagenic effect of alpha radiations to be chiefly lethal or sublethal. (auth)

21602 ULTRASTRUCTURE OF GIANT PLASTIDS IN A RADIATION INDUCED MUTANT OF OSMUNDA REGALIS. Allen, T. D.; Haigh, M. V.; Howard, A. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). J. Ultrastruct. Res.; 42: 491-501(Mar 1973).

A small proportion of Osmunda regalis prothalli, grown from irradiated spores, were observed to exhibit chloroplast mutants, one of which was termed spot. Spot mutant cells have their chloroplasts aggregated into one or more large masses, shown at the ultrastructural level to originate from fusion of pre-existing chloroplasts. These aggregates contain no internal separation, and were therefore termed giant chloroplasts. The giant plastids may contain over 1000 grana of normal proportions per section, and numerous osmiophilic droplets and starch grains. Peripheral reticulum and vacuoles were also observed within the giant plastids. Apart from some cytoplasmic vacuolation, the remainder of the cell contents did not appear to be altered in structure. (auth)

21603 INFLUENCE OF POSTIRRADIATION WASHING ON THE GROWTH AND MINERAL CONTENT OF TRIGONELLA FOENUM-GRAECUM L. SEEDLINGS. Freeman, J. R.; Aboul-Ela, M. M. (Texas Woman's Univ., Denton). Radiat. Bot.; 13: No. 3, 185-190(Jun 1973).

A dose of 30 kR γ radiation to seeds decreased fenugreek bean seedling height, fresh weight, and dry weight, especially as the seedlings grew older. This radiation dose also increased the observed nitrogen content, possibly due to the reduction in dry weight. Changes in phosphorus uptake were insignificant. A 15 kR dose decreased seedling heights and dry weights but not fresh weights. Intensive washing of nonirradiated seed for 24 hr under running water resulted in reduction of seedling heights, fresh weights, and dry weight but not if irradiated. The 15 kR dose, with or without the washing treatment, caused insignificant changes in the nitrogen and phosphorus contents of seedlings. The washing treatment per se decreased seedling dry weight at all age levels, suggesting that some growth-promoting factor (or factors) was removed by the washing process. (auth)

21604 EFFECTS OF FISSION NEUTRON, BETA, AND GAMMA RADIATION ON SEEDLING GROWTH OF DORMANT AND GERMINATING SEEDS OF BARLEY. Conger, B. V.; Killion, D. D.; Constantin, M. J. (Univ. of Tennessee, Oak Ridge). Radiat. Bot.; 13: No. 3, 173-180(Jun 1973).

Experiments were designed to study the effects of fission neutron (N_f), ^{60}Co γ and ^{90}Y β radiation on dormant and germinating seeds (caryopses) of barley, Hordeum vulgare L. cv. Himalaya. All seeds were adjusted to a water content of ~14% and the irradiations carried out in air. For studies with dormant seeds, the seeds were soaked after irradiation in nitrogen-bubbled water at 0°C for ~18 hr and then planted in blotter sandwiches. For studies with germinating seeds, the seeds were soaked ~16 hr at 0°C and then planted either in blotter sandwiches or with the embryo oriented upon blotters in Petri dishes and allowed to germinate for 24 hr before irradiation. The mean doses for the β radiation were calculated for that absorbed in the embryo by the first leaf, the endpoint measured. The results showed that γ- and β radiation were equally effective in reducing seedling growth of both dormant and germinating seeds. Fission neutron radiation was ~40 times more effective than either β- or γ radiation on dormant seeds at the D_{50} level of damage but only 6.8 times more effective on germinating seeds. The RBE's for γ/N_f and β/N_f decreased with increased dose and level of damage for germinating seeds but remained nearly constant for the dormant seeds. The germinating seeds were 5.0, 29.3, and 30.0 times more sensitive to N_f-, β, and γ radiation, respectively, than the dormant seeds at the D_{50} level of damage. These values also decreased with increasing dose and level of damage. (auth)

21605 INDUCTION OF SOME GRAIN SHAPE AND MORPHOLOGICAL MUTATIONS IN RICE, VARIETY IR-8. Reddy, G. M.; Reddy, T. P. (Univ. of Osmania, Hyderabad, India). Radiat. Bot.; 13: No. 3, 181-184(Jun 1973).

The dehusked and presoaked seeds of rice (Oryza sativa IR-8) were treated with 0.2 and 0.4% ethyl methanesulphonate, and 0.003 and 0.005 M diethyl sulphate. Dry and dehusked seeds were also exposed to 20 kR of γ rays. In the second generation the plants were screened for various morphological and grain size mutants. The induced morphological mutants include dwarfs, early maturing dwarfs, extreme tillering dwarfs, grassy dwarfs, plants with round grains, and boat-leaf mutants. The grain type

mutants varied from extremely round resembling japonica and indica varieties to long and slender in their shape and size. Mutants with translucent endosperm are being used in crossing programs and also for studying the genetic basis of the white belly region in the IR-8 grains. Some of the promising fine grain mutants with IR-8 plant type and with improved milling and cooking qualities are already in the hands of a few progressive cultivators and will be released for commercial cultivation after further trials. (auth)

21606 EFFECTS OF GAMMA RAYS ON SOME CHARACTERS IN EGYPTIAN COTTON. Bishr, M. A.; Abdel-Bary, A. A.; Zaitoon, M. A. (Alexandria Univ., Egypt). Egypt. J. Genet. Cytol.; 2: No. 2, 365-369(Jul 1973).

Dry seeds of three Egyptian cotton varieties were exposed to nine doses of γ rays, i.e., 0.5 to 20 Kr, from a ^{60}Co source. The M_1 and M_2 generations were studied for field and laboratory characteristics. In general, the effects of γ irradiation were dependent on the variety, i.e., the genetic make up; radiation doses; and the characteristics studied. Few abnormal plants were isolated mainly in the M_2 generation. Of these only the branchless type was of economic importance. (auth)

21607 EVOLUTIONARY QUALIFICATION OF SOME LEAF MUTANTS AND RECOMBINANTS OF PISUM. Gottschalk, W. (Univ., Bonn). Egypt. J. Genet. Cytol.; 2: No. 2, 219-238(Jul 1973).

By crossing different x radiation-induced leaf mutants of the pea (Pisum sativum), recombinants with strongly divergent leaf structures were obtained, which are of interest for the leaf evolution of the Leguminosae. Their competivity in relation to the parental mutants and phenotypically normal plants was studied using seed production as a criterion for judging the selection value. (CH)

21608 EFFECTS OF X-IRRADIATION ON VARIOUS LEVELS OF HETEROZYGOSITY IN MAIZE. Sahrigy, M. A.; Badr, E. A.; Torky, N. M. (Alexandria Univ., Egypt). Egypt. J. Genet. Cytol.; 2: No. 2, 206-218(Jul 1973).

The effects of x-irradiation on some cytological and morphological characters in different genotypes of maize varying in their levels of heterozygosity were studied. The seeds of three inbred lines, the F_1, F_2 of the single cross hybrids and the double cross hybrid were exposed to x rays at doses 5,000, 10,000, and 15,000 R. The morphological study was carried out on the X_1 and X_2 generations after irradiation and included the following characteristics: germination ratio, seedling survival, and mature plant height. The cytological examination was made to study the effect of x irradiation on the chiasma frequency, residual fragments, and chromosome rearrangement. The behavior of univalents was also followed in the different stages of the first meiotic division. The effect of x irradiation on pollen fertility was also studied in different genotypes. (auth)

21609 CHEMICAL NATURE OF RADIATION-INDUCED AND SINGLE-STRAND BREAKS IN THE DNA OF DORMANT BARLEY SEEDS IN VIVO. El-Metainy, A.; Tano, S.; Yano, K.; Yamaguchi, H. (Tokyo Univ.). Radiat. Res.; 55: No. 2, 324-333(Aug 1973).

Gamma irradiation of dormant barley seeds led to the production of DNA single-strand breaks, the liberation of inorganic phosphate, and the formation of phosphomonoester groups. For each single-strand break produced in DNA, 0.22 molecules of inorganic phosphate were liberated and 1.1 molecules of phosphomonoester groups were formed. Of the phosphomonoester groups formed, 40% were 5′-phosphomonoesters. Only 8.6% of the 5′-termini produced by radiation were 5′-hydroxyl termini. The chemical mechanisms involved in the induction of single-strand breaks in the DNA of dormant barley seeds are discussed. (auth)

21610 ANALYSIS OF IRRADIATION INDUCED VIRESCENT MUTANTS AND THE IDENTIFICATION OF A NEW VIRESCENT MUTANT (v_5v_5,v_6v_6) IN GOSSYPIUM HIRSUTUM L. Kohel, R. J. (Texas Agricultural Experiment Station, College Station). Crop Sci.; 13: No. 1, 86-88(1973).

Seven irradiation-induced virescent cotton (Gossypium hirsutum L.) mutants were analyzed. Four were duplicates of virescent-1 and two were duplicates of yellow-green. One virescent was independent of all known virescents. The new virescent was conditioned by recessive duplicate factors, and it was assigned the gene symbols v_5v_5,v_6v_6. Linkage analysis showed that the v_5 locus resides in the A subgenome on chromosome 1, adjacent to the L^L locus; and the v_6 locus is on the homeologous D subgenome chromosome 15, adjacent to the L^O locus. No recombination was obtained between v_5 and L^L or v_6 and L^O. The results of this investigation firmly establish the homeology between chromosomes 1 and 15. (auth)

21611 MODIFICATIONS OF THE ACTIVITY AND THE ISOENZYME PATTERN OF PEROXIDASE IN A TOMATO WIRY MUTANT. Scarascia Venezian, M. E.; Giacomelli, M. (CNEN, Rome). Agrochimica; 77: No. 5, 455-463(1972). (In Italian). (RT(BIO)-(72)37).

Irradiation of tomato pollen grains with ^{210}Po α particles (3000 R) yielded a mutant, designated wiry, with a filiform aspect of the leaves. A second generation cross with the parent yielded 4.1% wiry mutants. Cytological studies revealed no change in chromosome number and no visible chromosome aberrations in spite of up to 16% aberrant anaphases in mitoses of root apices. Mutant leaves presented an accelerated growth cycle. The total peroxidase activity, which is known to exert control over plant growth, was studied. Electrophoresis showed the presence of 6 isoenzyme bands in the mutant in contrast to 4 in the parent. Some F_1 parent-wiry progeny showed the parental bands but others did not. (CH)

21612 TRANSIENT ACTIVATION OF POTATO CHROMATIN BY GAMMA IRRADIATION. Nair, P. M. (Bhabha Atomic Research Centre, Trombay, India). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 30: No. 1, 61-64(Feb 1973).

Tubers were exposed to 10 krad of gamma radiation at a dose rate of 1330 rads/min. Buds were excised at intervals of 5 to 48 hr after irradiation and incubated in mixtures containing ^{14}C-uracil and ^{3}H-thymidine. Chromatin was isolated and purified from excised buds and template activity was determined. Synthesis of DNA and RNA was stimulated by radiation and a maximum was reached at 2 hr after irradiation; this was followed by a rapid decline. The significance of the results in relation to radioinduced inhibition of sprouting is discussed. (HLW)

21613 QUANTITATIVE VARIATION INDUCED BY GAMMA RAYS AND FAST NEUTRONS IN ARABIDOPSIS THALIANA. Daly, K. (Brookhaven National Lab., Upton, NY). Radiat. Bot.; 13: No. 3, 149-154(Jun 1973).

To test the effectiveness of radiations that differ in linear energy transfer (LET) for the induction of quantitative variation, dry seeds of Arabidopsis thaliana (L.) Heynh. (Cruciferae) were exposed to varying doses of ^{60}Co γ-rays and fast neutrons. Flowering time was delayed for all neutron treatments in the M_2 generation, but only at the highest γ ray dose level, 150 kR. Tests for increased variance in the M_2 generation due to irradiation were significant at each dose level of γ-ray and fast-neutron treatment. Fast neutrons were more efficient than γ rays for induction of genetic variance. This induced variance increased linearly with dose in the case of fast neutrons, implying that these quantitatively inherited variations arose primarily from chromosomal alterations, rather than point mutations. The absence of a similar dose-response relationship for γ rays is attributed in part to lack of enhancement of this radiation's effect due to reduced availability of oxygen immediately following irradiation in these experiments. (auth)

21614 COMPARATIVE RESISTANCE OF SOME RADIATION INDUCED JUTE PLANT MUTANTS TO JUTE WEEVIL, APION CORCHORI MARSH. Shahjahan, M.; Hamid Miah, M. A. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 59-63(Apr 1972).

Several mutants of the mother varieties, D-154 of (Deshi) Corchorus capsularis L. and C.G. of (Tossa) C. olitorius L. jute plants were examined in order to evaluate the degree of resistance to the jute weevil, Apion corchori Marsh (Curculionidae, Coleoptera). The mutants C-38 (high yielding) and C-26 (early maturing) of capsularis plants did not prove to possess any higher degree of resistance than that of the mother variety, D-154. However, the other mutants C-30, C-22 (seg) and C-23 (seg) showed a higher degree of apion-resistance. Among the olitorius population it appeared to decrease in all the mutants except 0-12, which was in the segregating stage. In general, the olitorius plants were more resistant than the capsularis plants. The percentages of plants attacked and the average attack per plant was much higher in the latter than in the former plants. Plant toughness, mucilaginous substances, plant chemicals, and some associated ecological phenomena were attributed to be responsible for such difference in the level of resistance. (auth)

21615 DESIGN OF A METHOD, USING IONIZING RADIATION, FOR THE INTRODUCTION OF ALIEN VARIATION INTO WHEAT. Kimber, G. (Indian Agricultural Research Inst., New Delhi). Indian J. Genet. Plant Breed.; 31: No. 3, 580-584(Nov 1973).

A method is described for the introduction of alien variation into wheat. A genetical screening is used to recognize the production of translocations and the method is designed to maximize the possibility of recovering the translocated segment while at the same time minimizing the labor involved. (auth)

21616 IMPROVEMENT IN QUALITY CHARACTERISTICS AND YIELD ATTRIBUTES THROUGH GAMMA-IRRADIATION IN RICE (ORYZA SATIVA L.). Govindaswami, S.; Ghosh, A. K.; Misra, R. N. (Central Rice Research Inst., Cuttack, India). Indian J. Agr. Sci.; 42: No. 10, 869-872(Oct 1972).

A hybrid rice culture CR 75-93 was treated with 15, 25, and 35 kR of gamma rays to improve its yield attributes and cooking quality. Out of a large number of mutants affecting several morphological characters isolated at M_2 and further tested at M_3, seven mutants were found to be quite promising. These had long slender grains, better cooking quality, and higher single-plant yield than the control variety. (auth)

21617 MORPHOGENESIS OF GREEN BUDS IN γ-IRRADIATED LEAF AND STEM EXPLANTS OF AUREA CHLOROPHYLL MUTANT NICOTIANA TABACUM L. Opatrny, Z.; Landa, Z. (Inst. of Experimental Botany, Prague). Biol. Plant. (Prague); 15: No. 2, 129-131(1973).

The formation of buds in leaf and stem explants derived from aurea mutant regenerants of Nicotiana tabacum (cv. John Williams Broadleaf, mutation Sulfur) was inhibited by dosages of 1 to 5 krad of γ irradiation. The extent of the inhibition was proportional to the dosage of irradiation. In some cases, the stem explants formed buds even after the application of 10 krad. In addition to aurea buds, green buds were also formed in both explants after the irradiation with the dosages of 1 to 2.5 krad that continued to grow even after the transplantation into garden soil. (auth)

21618 EFFECT OF ACUTE GAMMA IRRADIATION ON INITIATION AND MATURATION OF VASCULAR TISSUES IN STEMS OF CAPSICUM ANNUUM L. Iqbal, J. (Punjab Univ., Lahore). Biol. Plant. (Prague); 15: No. 3, 208-216(1973).

The effect of acute gamma rays (^{60}Co; 1 to 10 kR) on the vascular differentiation in stems of seedlings of Capsicum annuum L. long fruited cultivar at 8-leaf stage of development was studied. Procambium, phloem, and xylem of irradiated seedlings showed an early initiation and maturation in terms of distance from the tip. Magnitude of these differences increased with the increasing exposures and time following irradiation. In irradiated seedlings, there is a change in the developmental sequence of metaphloem and metaxylem when they first appear (in terms of number of leaf primordia). There is also a general increase in the number of procambial cells, sieve elements, and vessel elements after irradiation. The early initiation and maturation of the vascular tissue is correlated with the growth inhibition resulting from cell death and suppression of cell division activity in the shoot apex. (auth)

21619 EFFECT OF X RAY DOSES ON THE GROWTH OF WHEAT PLANTLETS TRITICUM AESTIVUM L. ESP. VULGARE. I. Marki, A.; Ochesanu, C.; Bianu-Morea, M. Stud. Cercet. Biol., Ser. Bot.; 24: No. 3, 227-236(1972). (In Rumanian).

The x-ray sensitivity of 12 races belonging to four botanical varieties of Triticum aestivum esp. vulgare were studied. The germination was little affected by irradiation, even at the highest doses of x rays. Therefore there is not a direct relationship between x-ray sensitivity and germination. The growth of the first leaf under the sublethal doses (15 to 20 kR.) has permitted the following classification of the races: 1. radiosensitive races (Bezostaia 1, Sinmartin milturum, and Cluj 62/63); 2. more radioresistant races (Autonomia, San Pastore, and Triumph); 3. races with an intermediate radiosensitivity (Sinmartin lutescens, Concho, Cluj 918, Cluj 722, and Cluj 11/54). A similar behavior was found in connection with high doses of x irradiation regarding the survival rate after 4 weeks. But the best method for a radiosensitive classification is the ratio of leaves/seedling after 4 weeks. The radiosensitive races have on the average five leaves/seedling for 20 kR applied. When the highest doses of x rays were applied (30 kR) the radioresistant races developed five leaves/seedling, while the sensitive sorts formed only one thin leaf. The taxonomical classification does not reflect any radiosensitive level of the races. (auth)

21620 MORPHOLOGICAL DESCRIPTIONS OF SOME INDUCED SYSTEMATIC MUTANTS OF GRAPES. Sharma, R. L. (Himachal Pradesh Univ., India); Mukherjee, S. K. Vitis; 11: No. 3, 177-188(1972).

During mutation induction studies on grapes (Vitis vinifera L.), conducted from 1967 to 1969, a large number of systematic, chlorophyll, and other types of somatic mutants were isolated in Bhokri cultivar after N-nitroso-methylurethane and gamma radiation treatments. The vegetative characters of 18 systematic mutants were described under six main groups 12 names. Some of these, viz. hept alobed and foliolate types, that have an increased number of lobes may be rare ones. A large number of systematic mutants had leaves with deeper sinuses and very acute and long teeth. On the contrary, there was one mutant (closed-petiolar sinus type), induced by NMUt, whose leaves were finely serrated and almost devoid of lateral sinuses, besides being thick and reflexed. Other mutants had glossy foliage or were dwarf with small, narrow leaves. The differences in the morphological features induced by gamma rays and NMUt are discussed in detail. (INIS)

21621 EFFECT OF GAMMA RADIATION ON GERMINABILITY, SEEDLING GROWTH, VIABILITY, AND MORPHOLOGY IN M_1 GENERATION OF THE TWO CULTIVATED JUTE VARIETIES. Saha, C. S.; Mia, M. M. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 1-5(Apr 1972).

Dormant seeds of about 10 to 11% moisture content of the variety D-154 of Corchorus capsularis L. and of the C. G. of Corchorus olitorius L. were irradiated with 40,000, 60,000, 80,000, and 100,000 R of gamma rays (^{60}Co). The germination percentage was negatively correlated with the radiation dose. The correlation was highly significant only in D-154. Both hypocotyl and radicle lengths established a highly significant negative correlation. The variety D-154 and C. G. were differently sensitive to radiation in survival and the variety D-154 was more radioresistant than C. G. Abnormal branching, deformed third leaf, fasciation and bifurcation of stem, clustering, asymmetry, and variegated leaves were observed. (auth)

21622 EFFECTS OF LOW AND HIGH DOSES OF GAMMA RAYS ON ALLIUM SATIVUM L., IPOMOEA BATATAS L., AND SOLANUM MELONGENA L. Rahman, M. M. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 6-8(Apr 1972).

Allium sativum L. (garlic), Ipomoea batatas L. (sweet potato), and Solanum melongena L. (eggplant) were exposed to low and high doses of gamma rays ranging from 2 to 100 kR. Treatments were administered to garlic bulbs, young shoots of sweet potato, and seeds of eggplant. High doses of gamma rays were either lethal or highly injurious for these species. Low doses reduced germination, seedling height, and dry weight of tops of garlic and sweet potato, but not of eggplant. Low doses also reduced survival of garlic plants and number of active buds per cutting of sweet potato. Flowering was delayed in eggplants by all doses except 2 kR. (auth)

21623 RADIATION SENSITIVITY STUDIES OF LATHYRUS SPECIES AND VICIA ERVILIA L. WILLD. IV. Dose-effects on Some Plant Characters. Shaikh, M. A. Q. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 9-16 (Apr 1972).

Dry seeds of seven species of Lathyrus and one species of Vicia were irradiated with 5 to 50 Krad doses of gamma radiation (^{60}Co). Both M1 and M2 populations were grown under controlled greenhouse conditions and dose-effects on some plant characters were studied. There was a decrease in plant height at maturity with an increase in radiation doses in L. tingitanus and L. clymenum, no effect in V. ervilia and L. sativus, increase in L. ochrus and L. nissolia following 5 Krad, and in L sphaericus and L. aphaca following all doses at which last surviving plants were found. Pollen sterility percentages in both generations increased progressively with dose in all species over their control samples but in the M2 generation the increase was much less than was observed in the M1. The percentages of sterile plants in L. sativus and V. ervilia increased in the treated samples in both the generations but the increase was not progressive with dose. Flowering and maturing were delayed in different degrees, in both the generations, depending on species and radiation doses. (auth)

21624 RADIATION INDUCED MUTANTS IN LATHYRUS SATIVUS AND THEIR MODE OF INHERITANCE. Shaikh, M. A. Q. (Atomic Energy Centre, Dacca, Bangladesh). Nucl. Sci. Appl., Ser. A; 6: 17-22(Apr 1972).

Air-dried seeds of Lathyrus sativus strain Barisal were irradiated with different doses of gamma rays. Mutants were isolated in the M_2 generation and their pattern of segregation was studied in the M_3 generation. The mutant types detected in the M_2 generation were narrow-leafed, dwarf, bushy, and whiteflowered. The mode of inheritance differed in the different types of mutants. Possible use of each mutant was suggested. (auth)

21625 RADIATION-INDUCED CHANGES IN THE CHEMICAL COMPOSITION OF SOLANUM TUBEROSUM CV. KUFRI SINDHURI TUBERS AFTER GERMINATION. Sharma, N. D.; Singh, U.; Vari, A. K.; Mathur, J. M. S. (Indian Agricultural Research Inst., New Delhi). Potato Res.; 16: No. 1, 53-56(1973).

The chemical composition of ^{60}Co γ-irradiated potato tubers (Solanum tuberosum cv. Kufri Sindhuri) after germination showed significant changes. The contents of "total" solanine, a glycoalkaloid, citric and ascorbic acids, and total solids increased. Malic acid decreased to some extent while pyroglutamic acid did not follow any regular pattern. Except glutamic acid all other free amino-acids increased. Under the influence of low doses titratable acids showed an appreciable increase but a 4-krad dose retarded their synthesis. No appreciable change was noted for nitrogen percentage. The size of the starch granules increased with higher doses and the quantity of anthocyanin decreases. (auth)

21626 MATURATION CHANGES IN FRUITS INDUCED BY GAMMA RADIATION. 7. Effects of Ionizing Radiation on Respiratory Rates, Ethylene Production, and Quality of Satsuma Oranges. Chachin, K.; Ogata, K. (Osaka Univ., Sakai, Japan). Shokuhin Shosha; 6: No. 1, 11-20(Jun 1971). (In Japanese).

Satsuma oranges were irradiated with doses of 50 to 200 Krad of ^{60}Co γ rays and with a dose of 150 Krad of electron beams (4 MeV). The browning of calyx and peel was caused by high doses. Browning of the peel but not of the calyx was prevented by storage at 6°C after irradiation. Carbon dioxide and ethylene production increased temporarily with irradiation. Ascorbic acid was oxidized to dehydroascorbic acid by gamma radiation immediately after irradiation, but not by electron beam irradiation. Titratable acidity in irradiated Satsuma oranges tended to decrease after irradiation. Sugar contents in irradiated samples decreased somewhat more than those of controls. Acceptance of Satsuma oranges lowered with the doses above 100 Krad. (HLW)

21627 MORPHOLOGICAL DESCRIPTIONS OF SOME INDUCED SYSTEMATIC MUTANTS OF GRAPES (VITIS VINIFERA L.). Sharma, R. L. (Himachal Pradesh Univ., Palampur, India); Mukherjee, S. K. Vitis; 11: No. 3, 177-188(1972).

During mutation induction studies on grapes (Vitis vinifera L.), conducted from 1967 to 1969, a large number of systematic, chlorophyll, and other types of somatic mutants were isolated in Bhokri cultivar after N-nitroso-methyl urethane and gamma radiation treatments. The vegetative characters of 18 systematic mutants were described under 12 names. Some of these which have an increased number of lobes may be rare ones. A large number of systematic mutants had leaves with deep sinuses and very acute and long teeth. On the contrary, there was one mutant, induced by NMUt, whose leaves were finely serrated and almost devoid of lateral sinuses, besides being thick and reflexed. Other mutants had glossy foliage or were dwarf with small, narrow leaves. The differences in the morphological features induced by gamma rays and NMUt are discussed in detail. (GF)

Radiation Effects on Animals

Refer also to abstract 22158.

Man

Refer also to abstracts 20776, 21059, 23265–23267, 23286, 23288, 23588, 23875–23877, and 24065.

21628 (BNL-17889) RADIATION EFFECTS DATA AND THEIR INTERPRETATION. Bond, V. P. (Brookhaven National Lab., Upton, N. Y.). 29 Mar 1973. 47p. (CONF-730444-1). Dep. NTIS $4.50.

From American Bar Association national institute on environmental litigation conference; Dallas, TX (12 Apr 1973).

A literature review is presented of radiation effects data with emphasis on possible late effects in the general population associated with relatively low doses of principally low LET radiations. Topics discussed are dosimetric concepts; somatic and genetic effects in toxicology; early and late clinical manifestations; dose-effect relationships in toxicology; dose rate effects; early effects of radiation; genetic effects; late effects in relation to high doses and dose rates; leukemia and cancer induction; radiation exposure of the public; internal emitters; risk to the individual; radiation and the Delaney amendment; and radiation protection guides. (28 references) (HLW)

21629 (CONF-721091-, pp P32.p1-P32.p3) PROTECTION TECHNOLOGY IN NUCLEAR TECHNIQUES. Vertut, J.; Guilbaud, J. P. 1972.

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Protection technology in the nuclear field is considered. International regulations, based on a careful study of these phenomena, stipulate the total acceptable dose for anyone working with nuclear materials. To ensure that radiation doses to staff are kept below these international standards, an extensive and very efficient protection technology has been developed. This fact has resulted in an increasing use in non-nuclear applications of the protection techniques proper to nuclear technology. (auth)

21630 (CONF-730907-5) ABSORBED DOSE TO SELECTED INTERNAL ORGANS FROM TYPICAL DIAGNOSTIC EXPOSURES. Poston, J. W.; Warner, G. G. (Oak Ridge National Lab., Tenn.). 1973. 8p. Dep. NTIS $3.00.

From third international congress of the international radiation protection association meeting; Washington, District of Columbia, USA (9 Sep 1973).

A Monte Carlo-type computer program was developed which can be used to estimate the radiation dose received by various organs and tissues due to external photon beams typical of those employed in x-ray diagnostic studies. Two diagnostic x-ray procedures were simulated on a computer for these studies. Eight computer runs consisted of a set of exposures each of which simulated a chest x-ray radiogram and eight runs consisted of a set of exposures each of which simulated a G. I. tract x-ray radiogram. The targets for these studies were two anthropomorphic phantoms. One is that of an adult human body that contains 23 internal organs including gonads, lungs; four parts of the G. I. tract; ten skeletal parts with provisions for red and yellow marrows; skin; and tissue that includes muscle. The bone marrow and the bone are mixed homogeneously in the skeleton of this phantom. The other phantom is called a geometric phantom. Whereas, in toto, it has the same outer dimensions and the same mass and composition of the human phantom, it is divided into dose regions by cutting planes and curves. The trunk of the phantom has five layers, is divided into five concentric cylinders, and is cut by four vertical cross planes. This results in 85 subregions in which depth dose may be determined. Both phantoms are heterogeneous by virtue of their composition which consists of 3 distinct media: tissue, lung, and bone with their concomitant densities and attenuation and absorption properties. Data on depth dose distribution in the trunk for the simulated diagnostic chest x-ray exposures are presented. (CH)

21631 (COO-2273-1) RADON PROGENY CONTROL IN BUILDINGS. Final Report. Culot, M. V. J.; Olson, H. G.; Schiager, K. J. (Colorado State Univ., Fort Collins). May 1973. Contract AT(11-1)2273. 276p. Dep. NTIS $16.00.

Thesis. Submitted by Culot, M. V. J.

The use of uranium mill tailings as a construction material for and around habitable structures has resulted in chronic whole-body gamma exposures of the population and in increased radon daughter lung exposures to the occupants. The use of sealants designed to prevent radon diffusion into the structures was investigated for application in the most frequently encountered case, i.e., where the γ exposure levels do not warrant the costly removal of the tailings, but where the radon daughter concentration exceeds the standards set for the radiation exposure of the general public. A review of the parameters affecting the diffusion of radon in concrete, and a method to evaluate the effective diffusion coefficient of a concrete slab, are presented. The modifications introduced in the radon concentration profiles by a radon barrier are evaluated by application of a linear diffusion model to a multilayered system of porous media. The results of a testing program that led to the identification of an effective radon sealant are presented with the experimental evidence demonstrating the effectiveness of the sealant by the successful reduction of the average radon concentration following its application in an experimental building. (CH)

21632 (FMI-39) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Gottschalk, A. (ed.) (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). Mar 1973. Contract AT(11-1)-69. 137p. Dep. NTIS $5.45.

Research activities are summarized and references to published papers on the various research projects, including radiotherapy, are given. (MCG)

21633 (FMI-1000-434) MEDICAL PHYSICS ASPECTS OF PARTICLE ACCELERATORS IN RADIATION THERAPY. Lanzl, L. H. [nd]. 2p. (CONF-721045-3). Dep. NTIS $3.00.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

The importance of precise and accurate dosimetry in radiotherapy is discussed. The use of computers in quality control of the radiation dose during therapeutic use of charged particles is stressed. (CH)

21634 (IAEA-R-529-F) WHOLE-BODY COUNTING OF POPULATIONS LIVING IN AREAS OF HIGH NATURAL RADIOACTIVITY. Final Report, 1 September 1967–31 June 1971. Cullen, T. L. (International Atomic Energy Agency, Vienna (Austria)). May 1971. 12p. INIS.

Equipment was set up in Rio de Janeiro to measure the thorium-series activity in persons living in Guarapari, a town situated on or near thorium-containing monazite sands. The equipment consists of a 15 cm $\phi \times 10$ cm NaI(Tl) detector, a multichannel analyzer, and a steel shield of 10 to 20 cm thickness. The subjects are measured in the sitting position, with the detector suspended over their laps. Calibration is achieved using plastic containers resembling in size and shape a seated man and filled with solutions of appropriate radionuclides. The measurement program has not yet been completed, but thorium-series activity has been detected in several residents of Guarapari at a level of the order of 10 nCi. Future investigations may give a clearer picture of the ranges of activity levels found in persons of various ages and occupations. (INIS)

21635 (KFK-1818) ANNUAL REPORT FOR 1972. Kiefer, H.; Koelzer, W. (Kernforschungszentrum. Karlsruhe (West Germany)),

May 1973. 166p. (In German). Dep. NTIS (U. S. Sales Only) $10.50.

Information on the different duties, lists of results of routine measurements in 1972, and recent results of investigations and developments in the working groups of the department are presented. (GE)

21636 (KURRI-TR-101) REPORT OF RADIATION MONITORING IN LABORATORIES. 8. Katsurayama, K.; Tsujimoto, T.; Saito, M.; Tsuruta, T.; Fukui, M. (Kyoto Univ. (Japan). Research Reactor Inst.). 1 Apr 1972. 28p. (In Japanese). NTIS (U. S. Sales Only).

In the KURRI, for indoor radiation control, the following items have been measured since its establishment in the reactor room, hot laboratory, tracer laboratory, and waste treatment facility: spatial dose rate cumulative dosage, surface contamination, water radioactivity, and radioactive dust and gas. These activities of the radiation control and records in the year 1971 are presented. Radioactive gas concentration in the reactor room and in the air from stacks has been on the increase in recent years; results of measurement carried out to cope with this problem are described. On the other hand, with increase in the utilization of D_2O facility, dosage measurement was made more minutely. Radiation monitors used for the past 7 or 8 years since the KURRI's establishment are described with regard to their performance. (JA)

21637 (N-73-18106) MEDICAL ASPECTS OF SPACE FLIGHT SEEN FROM THE VIEWPOINT OF NUCLEAR MEDICINE. Johnson, P. C.; Driscoll, T. B. (Baylor Univ., Houston, Tex. Coll. of Medicine). Nov 1972. 8p.

Radionuclide volume measurements performed on crews of selected Apollo missions indicate the following: invariably, there is a small drop in red-cell mass of the returning crewmembers. Plasma-volume decreases similar to those experienced during bedrest are found in crewmen of short Gemini missions. After longer missions, the plasma-volume decrease is no longer present. Extracellular- and total-body water changes prove that spaceflight weight loss includes actual tissue losses. The loss of total-body exchangeable potassium after the Apollo 15 mission is evidence of increased aldosterone secretion. (STAR)

21638 (N-73-19133) RADIATION PROTECTION HANDBOOK. (National Aeronautics and Space Administration, Cocoa Beach, Fla. John F. Kennedy Space Center). 29 Nov 1972. 62p. (NASA-TM-X-69410). NTIS.

A handbook that sets forth the Kennedy Space Center radiation protection policy is presented. The book also covers administrative direction and guidance on organizational and procedural requirements of the program. Only ionizing radiation is covered. (STAR)

21639 (NP-19823) BIOLOGICAL EFFECTS OF NUCLEAR EXPLOSION FALL-OUT. (Australian Academy of Science, Canberra). Apr 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The AAS committee concluded that there was no reason to question the estimates of radioactive fallout used in the reports from other authorities; its own independent assessment is given in an Appendix. At low doses of radiation on animals or on man, it is not known whether the effects are proportional to dose. There may be a threshold below which lower levels of radiation have no effect. Current work on repair by living cells, of damage they have suffered at high doses of radiation, suggests that low doses may not cause cancer or genetic defects at a rate proportional to dose. It is assumed (as all official reports have hitherto done) that the responses to dose are proportional over the whole range. Australia, as the result of the French tests which have already taken place, could have one case of thyroid cancer per year due to the isotope ^{131}I and one to four other cancer cases per year due to ^{90}Sr, ^{137}Cs, and ^{14}C. Due to the same isotopes, Australia could have one mutation in every 10 years leading to death or disability in the first generation, and up to 50 to 100 deaths or disabilities in all subsequent generations. In the improbable event of an explosion of a high-powered bomb combined with quite exceptional meteorological conditions some increase in the above figures would be expected. Thyroid cancer cases due to ^{131}I could be about 10. Other cancer cases due to the other isotopes could increase to much higher figures than at present levels of radiation. Mutations could lead to two deaths and disabilities per year in the first generation and to more than a thousand deaths and disabilities in all subsequent generations. (AT)

21640 (ORAU-118) COOPERATIVE GROUP TO STUDY LOCALIZATION OF RADIOPHARMACEUTICALS. Kniseley, R. M. (Oak Ridge Associated Universities, Inc., Tenn. Medical Div.). 1973. 9p. Dep. NTIS $4.00.

A group of clinical investigators mostly from institutions in the southeast formed The Cooperative Group to Study Localization of Radiopharmaceuticals. A discussion is presented of objectives of the group, mechanics of organizing it, and various problems peculiar to the cooperative studies and their possible solutions. Some problems discussed are administrative and logistical problems, instrument calibration, uniformity of scan interpretation, and collection and analysis of data. (HLW)

21641 JOINT DENTAL RADIATION SURVEY IN PUERTO RICO, 1968. Gileadi, M. (Puerto Rico Nuclear Center, College Station, Mayaguez). Radiat. Data Rep.; 14: No. 6, 351-355(Jun 1973).

The objective, scope, and methods used in the 1968 Joint Dental Survey Project, sponsored jointly by the Health Department of Puerto Rico Nuclear Center and School of Dentistry, University of Puerto Rico, are described. Health hazards associated with dental x-ray diagnostic procedures in Puerto Rico in 1968 are evaluated, and relevant statistical and technical data pertinent to the use of x rays in the dental profession on the Island are presented. (auth)

21642 RADIATION SAFETY IN WORK WITH GENERATORS OF SHORT-LIFE ISOTOPES. Zubovskii, G. A.; Korenkov, I. P.; Pertsov, V. A.; Sokolina, L. L.; Naumenko, Yu. I. Gig. Sanit.; No. 5, 47-50(May 1973). (In Russian).

The monthly average dose of external irradiation of medical nurses amounts to 200 to 250 mR, and that of their hands amounts to 900 to 1100 mR. These irradiation levels are below the maximal permissible values set by NRB-69. (auth)

21643 INCREASE OF THE MAN'S RADIATION LOAD AND THE CONCLUSIONS TO BE DRAWN FROM IT. Wachsmann, F. Magy. Radiol.; 25: No. 3, 129-138(1973). (In Hungarian).

Besides the natural radiation load, artificial radiation sources had an effect on man in the last decades. Radiation treatments in medicine are of importance, since in some countries during the x-ray diagnostic examinations the x-ray staff was exposed to ray doses of 50 to 100 mrem yearly. Also the radiation loading due to the nuclear medicine is considerably increasing. Notwithstanding it does not seem necessary to impose strict restrictions in the domain of the medical use of the radiations in the near future. On the other hand, working out of certain technical procedures may be necessary, which may diminish man's radiation load, so much the more as radiation due to the atom bomb experiments, to the atomic power generating stations, as well as to the increasing use of the radiations in engineering and in the economic and scientific life show a rising tendency. (auth)

21644 CONTROLLING OF CLOSED RADIUM PREPARATIONS AND THEIR USE. Bozoky, L.; Gacs, F.; Lendvay, J. Magy. Radiol.; 25: No. 2, 107-112(Apr 1973). (In Hungarian).

Classical radium preparations are used in Hungarian radiation therapy on a large scale. As a consequence, critical examination of radiation protection in working places where radium therapy is done and protection against radiation injuries are of utmost importance. The characteristics of the actually used radium preparations and the modern possibilities of the protection against radiation injuries are summarized with special respect to the admissible reduced level of external radiations and to the special incorporation possibilities to be observed during the use of radium preparations. The problems arising in connection with accidents, the methods of the inspection in situ, and the responsibility are discussed. (auth)

21645 SITES OF RADIATION-INDUCED BREAKAGE IN HUMAN LYMPHOCYTE CHROMOSOMES, DETERMINED BY QUINACRINE FLUORESCENCE. San Roman, C.; Bobrow, M. (Medical Research Council, Oxford). Mutat. Res.; 18: No. 3, 325-331(Jun 1973).

We have examined the distribution of 298 radiation-induced breakpoints in human chromosomes by quinacrine fluorescence. Very little damage was discovered that would not have been detectable with simple staining methods. The data suggest an excessive number of breaks in chromosome 3 and a deficit in No. 16. The participation of chromosomes in rearrangements appears to be proportional to chromosome length. Within chromosome arms, breakpoints are selectively placed in telomeric regions. (auth)

21646 COMPARISON OF RADIATION-INDUCED CHROMOSOME ABERRATION YIELDS FOLLOWING CULTURE IN TWO TYPES OF SYNTHETIC MEDIA. Purrott, R. J.; Lloyd, D. C. (National Radiological Protection Board, Harwell, Eng.). Mutat. Res.; 18: No. 3, 371-373(Jun 1973).

Experiments are described in which the aberration yields and transformation rates in irradiated and unirradiated human lymphocytes are compared for two commonly used synthetic media. Based on the criterion of aberration yields in the lym-

phocytes, the media seemed identical and were thus unlikely to be the cause of the reported differences in aberration yield at various dose levels. (ERB)

21647 PENUMBRA EFFECT ON INTEGRAL ABSORBED DOSE IN ^{60}Co TELETHERAPY. Moon, P. S. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 87-93(Jun 1973).

Due to the ^{60}Co γ source size, the penumbra in ^{60}Co teletherapy poses a serious problem, even if extended collimators are used. An empirical formula for the calculation of integral absorbed dose in the penumbra region was derived. Through a numerical calculation, the penumbra effect on integral absorbed dose was investigated. The longer the source-to-skin distance, the larger the integral absorbed dose of the penumbra region, and the larger the source diameter, the larger the integral absorbed dose of the penumbra region. It was also found that in some case the integral absorbed dose in the penumbra region became several times larger than the integral absorbed dose of the treatment region itself if the source-to-skin distance was greater. It was concluded that the penumbra effect must be considered in ^{60}Co teletherapy. (auth)

21648 RADIATION-HYGIENIC ASSESSMENT OF X-RAY EXAMINATIONS. Stavitskii, R. V.; Dermendzhiev, Kh. T.; Dolmat, E. S. Gig. Sanit.; No. 6, 47-51(Jun 1973). (In Russian).

In most types of x-ray examinations, shielding of the sexual parts of the body make it possible to reduce considerably the radiation load produced on the gonads. The use of modern technical equipment diminishes the extent of irradiation of gonads in the course of performance of the most hazardous x-ray examinations in respect to irradiation. (auth)

21649 RADIATION OSTEOMYELITIS OF THE UPPER JAW. Vorob'ev, Yu. I. (Moscow Medical Stomatology Inst.). Med. Radiol.; 18: No. 7, 25-29(Jul 1973). (In Russian).

Radiation osteomyelitis of the upper jaw was observed in 18 out of 127 patients (14 ± 3%) with malignant tumors after a radical course of megavolt therapy. Radiation injuries of the upper jaw bone developed mainly during the first and second years after the termination of radiation therapy and affected, in most of the cases, the alveolar process. Incidence of osteomyelitis depended upon the value of the total focal dose. (auth)

21650 TREATMENT OF BONE SARCOMAS OF THE EXTREMITIES BY RADIATION THERAPY UNDER TOURNIQUET HYPOXIA. Balmukhanov, S. B.; Akhmetbekova, K. A.; Pozdnukhov, L. G.; Karibdjanova, Z. B.; Zholkiver, K. I.; Kauashev, S. K.; Khusnutdinova, G. I.; Iliassova, K. A. (Inst. of Oncology and Radiology, Alma-Ata, USSR). Neoplasma; 20: No. 3, 341-346 (1973).

The method of radiation therapy under tourniquet hypoxia was used in the treatment of 75 patients with bone tumors. In 32 cases, the treatment was combined with local hypothermia. Transient improvements of the disease were observed. Clinical data, late results, as well as the side effects of the used method are discussed. (auth)

21651 BONE MATURATION IN CHILDREN EXPOSED TO THE A-BOMB IN UTERO. Russell, W. J.; Keehn, R. J.; Ihno, Yu.; Hattori, F.; Kogure, T.; Imamura, K. (Atomic Bomb Casualty Commission, Hiroshima). Radiology; 108: No. 2, 367-374(Aug 1973).

Postero-anterior roentgenograms of the hands and wrists of 556 subjects exposed to the Hiroshima and Nagasaki A-bombs in utero were observed and the age at which epiphyseal closure occurred was recorded. Closure occurred 6 to 7 months later in boys and 8 to 9 months later in girls, compared to published results for other Japanese and American children. Possible contributory factors are discussed. There was no correlation between the exposure dose to the mother and the time of closure in children exposed in utero, contrary to a previous report that delayed bone maturation is attributable to atomic radiations. A norm for epiphyseal closure is included. (auth)

21652 NUCLEAR REACTORS: THE EMPLOYEE MONITORING AND SAFETY PROGRAM. Spickard, J. H. (Atomic Energy Commission, Idaho Falls, ID). J. Occup. Med.; 15: No. 4, 343-345 (Apr 1973).

Personnel working at reactor facilities operate under radiation exposure guidelines developed by experts in the field of radiation biology. Accidents from all causes in AEC and contractor operations have been less than the industrial averages in both severity and frequency. Personnel monitoring and safety programs are reviewed. It is concluded that the atomic energy field, including nuclear reactor operation, is a comparatively safe industry and that the environment and personnel exposures are well controlled. (CH)

21653 THYROID CARCINOMA AND RADIATION. A Chicago Endemic. DeGroot, L.; Paloyan, E. (Univ. of Chicago). J. Amer. Med. Ass.; 225: No. 5, 487-491(30 Jul 1973).

Radiation-associated thyroid carcinomas continue to occur with alarming frequency. Among 50 patients with thyroid carcinoma seen over the past four years, 20 had received prior neck x-ray treatment. These patients developed tumors an average of 20 years after x-ray exposure and were nearly all under 35 years of age. Clinical findings were similar to those of the nonexposed carcinoma patients, but the tumors were less invasive and never undifferentiated. One patient in the x-ray group succumbed to the illness. Two-thirds of the patients who have a history of known x-ray exposure and who showed clinical thyroid abnormalities had cancer. All patients who received significant x-ray exposure to the neck region during childhood or adolescence should be examined for thyroid abnormalities, which may develop two or more decades after exposure. (auth)

21654 MAN AND ENVIRONMENT. II. Second National Biological Congress, Miami Beach, Florida, October 23-26, 1971. Washington, DC; American Institute of Biological Sciences (1971). 97p. (CONF-711079-(Absts.)).

One paper presented at the conference was concerned with the effects of radiation on man. Hazards of radiation were discussed with regard to radioinduced mutations in man, exposure to radioactive emissions of nuclear power plants, and medical exposure of the human fetus to radiation. An additional 36 papers were presented on various aspects of human ecology. (HLW)

21655 RADIATION NECROSIS OF THE LARYNX. Stell, P. M.; Morrison, M. D. (FRCS, Liverpool). Arch. Otolaryngol.; 98: No. 2, 111-113(Aug 1973).

The response of the larynx to radical doses of radiotherapy varies from mild erythema to severe inflammation with edema and induration, possibly leading to necrosis of cartilage. Necrosis is mediated by bacterial infection in traumatized tissue having greatly reduced healing power. This complication may be fatal, and if not, its treatment is difficult and lengthy. Possible etiologic factors discussed include short treatment times, large treatment fields, chronic respiratory tract infection, and generalized arteriosclerosis. Early cases may respond to medical treatment, but once cartilage necrosis has occurred, a laryngectomy is required. Excision of affected neck skin and wound closure at a later date is advocated in order to limit spread of infection. (auth)

21656 HISTOPATHOLOGY OF IRRADIATED AND OBSTRUCTED SUBMANDIBULAR SALIVARY GLANDS. Harwood, T. R.; Staley, C. J.; Yokoo, H. (Veterans Administration Research Hospital, Chicago). Arch. Pathol.; 96: No. 3, 189-191 (Sep 1973).

Twenty-six cases of histologically altered submandibular glands were reviewed in detail. In addition to previously described acinar destruction, duct changes, and fibrosis, two additional histologic criteria useful in differentiating obstructed from irradiated submandibular glands were noted. Atypical epithelial nuclei in acini and ducts and intralobular fat were found in irradiated glands. Neither atypical nuclei nor intralobular fat were found in obstructed glands. These additional histologic criteria will augment the diagnostic accuracy in separating the two entities. (auth)

21657 RADIATION BIOLOGY AS IT RELATES TO RADIOLOGIC TECHNOLOGY. Mueller, P. O. (St. Paul's Hospital, Dallas). Radiol. Technol.; 45: No. 1, 1-14(1973).

Various aspects of radiation biology of interest to radiologists are reviewed. A table is presented to show maximum permissible doses for individuals as established by the ICRP and the United States National Council on Radiation Protection and Measurements from 1925 to 1971. A cytogenetic survey of radiologists revealed an increase in the number of chromosome mutations over the number in control individuals. Legal aspects and genetic hazards of low-dose irradiation are discussed. A discussion is presented of cell structure including the molecular structure of DNA in relation to genes and chromosomes. The karyotype of normal human chromosomes is illustrated and discussed and radioinduced mutations are briefly reviewed. Hazards to human germ cells and fetuses following medical exposure to x rays are emphasized. (HLW)

21658 PULMONARY EFFECT OF MANTLE IRRADIATION IN PATIENTS WITH HODGKIN'S DISEASE. Lokich, J. J.; Bass, H.; Eberly, F. E.; Rosenthal, D. S.; Moloney, W. C. Radiology; 108: No. 2, 397-402(Aug 1973).

The effect of mantle irradiation therapy for Hodgkin's disease on physiologic indices of pulmonary function including lung volume, flow rates, and diffusing capacity was monitored serially in 11 patients. Lung volumes including total lung capacity (TLC) and inspiratory capacity (IC) were maximally affected at nine

months but returned toward normal by 24 months. Diffusing capacity was reduced prior to radiotherapy and decreased further following treatment in more than 50% of the patients. Patients with intrathoracic Hodgkin's disease had lower initial pulmonary indices, which improved with tumor resolution on radiotherapy, and patients without intrathoracic disease had a comparatively greater decrease in pulmonary function following irradiation, but this was transient and recoverable. (auth)

21659 HIGH ENERGY ELECTRON THERAPY. Matsuda, T. (National Hospital of Nagoya, Japan). Iryo; 26: No. 11, 943-954 (Nov 1972). (In Japanese).

Fundamental and clinical problems of electron therapy are presented on the basis of the author's experience on 760 clinical cases of dermatoma, mammary carcinoma, lymph node metastasis, cancer of the oral cavity, laryngeal cancer, thyroid carcinoma, and sarcoma treated by means of Siemens 18 MeV Betatron and Toshiba 13 MeV linac since July 1963. Several modified betatron therapies were developed by the author during the treatment with application of tomography, beam flattening filter, electron flux, monitoring device for intracavitary irradiation, electron pendulum irradiation, and combined betatron therapy with x radiation according to the type of lesions. Special features in the discussion of betatron therapy are: less damage is observed in the normal tissues close to the lesion; it can be applied for tissues around the critical organ; irradiation can be possible to the lesions such as oral cavity, larynx, or vagina which are hard to be treated by regular radiotherapy; therapy can be applied for recurrent cases of post radiotherapy; it can be effective to lymphatic node metastasis and laryngeal cancer; and relative biological effects are higher with betatron therapy on the tumor of less radiosensitivity. (JA)

21660 CANCER AS A CAUSE OF ABORTIONS AND STILLBIRTHS: THE EFFECT OF THESE EARLY DEATHS ON THE RECOGNITION OF RADIOGENIC LEUKAEMIAS. Stewart, A. M. (Oxford Univ.). Brit. J. Cancer; 27: No. 6, 465-472(Jun 1973).

Data from the Oxford Survey have shown that childhood cancers are causes of in utero deaths that affect leukemias more than solid tumors and difficult deliveries more than easy ones. As a result of these biases singletons give the impression of being more leukemia-sensitive than twins. This is a false impression that affects other situations and makes it more difficult to detect the leukemogenic effects of obstetric radiography in a prospective survey than in a case-history survey, and essential to look for these effects beyond the period affected by the in utero deaths. (auth)

21661 EMERGENCY MEDICAL MANAGEMENT. Twenty-first Hahnemann Symposium, Philadelphia, Pennsylvania, December 8-12, 1969. Spitzer, S.; Oaks, W. W. (eds.). New York; Grune and Stratton, Inc. (1971). 487p. (CONF-691234-). $25.00.

A separate abstract was prepared for one paper presented at the symposium. An additional 48 papers were presented on various aspects of cardiovascular, pulmonary, endocrine, neurologic, psychiatric, obstetrical, and pediatric emergencies. (HLW)

For abstract of an individual paper see: 21663.

21662 HEALTH AND SAFETY ASPECTS. Duursma, E. K. (International Lab. of Marine Radioactivity, Monaco); Hours, R.; Leo, G. pp 229-231 of Tracer Techniques in Sediment Transport. Vienna; International Atomic Energy Agency (1973).

From panel meeting on the use of tracers in sedimentology; Paris, France (21 Jun 1971). See STI/DOC-10/145; CONF-710665-.

The risks of toxicity from using nonradioactive tracers for sediment transport studies should be evaluated and compared with the risks encountered from the use of radioactive tracers that have the advantage of decaying. (ERB)

21663 NUCLEAR ACCIDENTS AND THEIR MANAGEMENT. Linnemann, R. E. (Univ. of Pennsylvania, Philadelphia); Holmes, R. H. pp 281-292 of Emergency Medical Management. Spitzer, S. (ed.). New York; Grune and Stratton, Inc. (1971).

From 21st Hahnemann symposium on emergency medical management; Philadelphia, Pennsylvania, USA (8 Dec 1969). See CONF-691234-.

It is pointed out that radiation accidents are very infrequent considering the increasing role of ionizing radiation in medicine, industry, and research. Radiation accidents are classified as those due to whole-body or local radiation exposure, those due to internal or external radiation contamination, and those due to combined exposure and contamination. A discussion is presented of the effects of radiation contamination with regard to alpha, beta, and gamma radiation. The regional approach to the management of accident victims is described as the development of a closely coordinated regional master plan in which one medical center assumes responsibility for the total evaluation and care of any accident and other hospitals in the region develop their plans in accordance with their capability. Requirements for a radiation emergency plan for supporting hospitals are listed as follows: identification of the contaminated patient; determination of the extent of radiation hazards; treatment of the medical condition; call for assistance; decontamination; evacuation of the patient; and confinement of subsequent facility contamination. (HLW)

21664 EPIDEMIOLOGY OF INFECTIOUS AND NON-INFECTIOUS DISEASE: SOME COMPARISONS. Lilienfeld, A. M. (Johns Hopkins Univ., Baltimore). Amer. J. Epidemiol.; 97: No. 3, 135-147(Mar 1973).

The following aspects of infectious and non-infectious diseases are reviewed: observations of occurrence of disease in man; natural experiments; randomized controlled experiments in epidemiology; and theoretical epidemiological studies using mathematical models and computer simulation. Data from a study of childhood leukemia are analyzed with respect to the following factors: pre-conceptional radiation; maternal reproductive wastage; history of childhood virus diseases; and intra-uterine radiation. With regard to radioinduced leukemia, a discussion of relative risks of preconceptional and postconceptional radiation is presented. (HLW)

21665 ENVIRONMENTAL ASPECTS OF NUCLEAR POWER STATIONS. Bethlendy, G. Environ. Lett.; 4: No. 3, 151-185 (1973).

The rapid growth in nuclear power production will increase the amount of radioactive wastes that must be managed in a way that avoids environmental pollution. The technology of waste management is discussed along with electricity requirements. Attention is being given to a number of problems such as the thermal effects of nuclear power plants, the improvement of the technology and safety procedures, and the control of radioactive effluents. (MCG)

21666 LARYNGEAL RECONSTRUCTION AFTER SUBTOTAL LOSS OF CARTILAGE DUE TO RADIATION PERICHONDRITITIS. Theissing, G. (Univ., Erlangen-Nuernberg, Ger.). Z. Laryngol., Rhinol., Otol.; 52: 54-58(Jan 1973). (In German).

The reconstruction of the larynx with an adequate airway, after extensive radiation perichondritis, requires complex plastic procedures and Rethi's method proved satisfactory. The principle of laryngo-tracheal reconstruction rests in the application of a Y shaped tubed pedicle flap from the chest skin. The limbs of this are placed at the upper end of the laryngostome and sutured exactly in place at the side edges. Final closure is achieved by thinning the stem of the Y flap and swinging it up to form the outer cover. Where the two limbs divide, a cleft of about 1 cm is left, thus permitting the introduction of a thin suction tube to deal with the common swallowing difficulties due to the sensory denervation of the laryngeal inlet. A functionally complete closure of the laryngostome is achieved where the flap had been swung up to form an overlapping outer cover. (auth)

21667 ROUTINE MONITORING OF WORKING PERSONNEL. Ackers, J. G. (Reactor Centrum Nederland, Petten). pp B.2.1-B.2.3 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

In the early days of the work at the site at Petten (around 1960) every member of the personnel was monitored for external radiation by a film badge (β, γ, n) and for internal contamination by whole-body counting once a year. Later, when the number of employees had grown rapidly and the work was marked off more clearly, a group of so-called radiation workers was defined according to legal rules. Only these workers were held to have a film badge, and were monitored by whole-body counting once a year on a routine basis, whereas the other employees were measured once in two years. Suppose an individual is monitored (for internal contamination) on a routine basis having regular time intervals of T days. Let once the monitoring instrument indicate a burden of A nCi of a certain nuclide in the body or specified organ. To calculate the dose equivalent it is, besides having a knowledge of metabolism factors and physical data concerning the nuclide involved, necessary to make at least a guess about the pattern of intake. This guess is an origin of inaccuracy, the effect of which can be diminished by increasing the measuring frequency. The decision of what inaccuracy is acceptable is a very personal one. It is however right to evaluate the influence of different patterns of intake on the dose evaluation. This goes as well for the measuring frequency. To make the problem more easy to deal with, we concentrate upon the routine monitoring of ^{131}I in the thyroid with a frequency of once per T days. (auth)

21668 DETERMINATION OF INTERNAL CONTAMINATIONS BY EXCRETA MEASUREMENTS. Koch, G.; Dulcino, J. (Centre

d'Etude de l'Energie Nucleaire, Mol, Bel.). pp B.6.1-B.6.19 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

Among the measures intended to ensure the safety of workers exposed to internal contamination, the control program for personnel, either by direct measurement of the internal contamination or by indirect measurement of excreta, constitutes a useful if not essential element. In addition, these measurements are necessary to estimate the importance of any incident. Though the direct measurement of the activity seems to be the most adequate measurement, it is to be noted that it has limitations for numerous nuclides if one wants to detect fractions, even reasonably small, of the maximum permissible burden. This is the case, for example, for many transuranium elements, of which the γ activity can only be estimated with a low measuring sensitivity and for which the transposition of the results in terms of body burden presents great difficulties due to the uncertainties affecting the absorption coefficients of the radiations in tissue. The existence of these limitations makes excreta measurements the logical and essential complement to the direct measurements, permitting an indirect approach to the problem. The excreta measurements are thus used not only in routine, in a preventive way to ensure the safety of operations, but also after an incident in order to evaluate its magnitude, within the limits of our knowledge about excreta phenomena. The principal types of excreta measurements are: the urine measurements, the nasal mucus measurements, and the feces measurements. (BE)

21669 RADIATION EXPOSURE TO PERSONNEL USING RI INJECTOR FOR ^{99m}Tc AND ITS SHIELDING EFFICIENCY. Kaneko, M. (Nagoya Univ., Japan); Watanabe, M.; Yamamoto, C. Radioisotopes (Tokyo); 22: No. 4, 201-203(Apr 1973). (In Japanese).

21670 INTEGRAL ABSORBED DOSES RECEIVED BY THE PATIENTS DURING X-RAY DIAGNOSIS AND MEASURES OF RADIATION PROTECTION. Telichko, F. F. Vestn. Rentgenol. Radiol.; No. 3, 57-63(1973). (In Russian).

By studying the effect of intensity, filtration, area, and distance on the integral absorbed dose, a comparison was made of the rate of reduction of this dose in the area under study in case of various combinations of conditions of study. The greatest reduction of the integral absorbed dose was reached by diminishing the irradiated area to the size of the area under study, by the maximally useful radiation filtration with a simultaneous slight increase in intensity. Recommendations for reducing the radiation load per patient during the x-ray diagnosis without diminishing the efficacy of protection of the personnel and lessening the quality of this investigation are given. (auth)

21671 VOLUME OF DOSIMETRIC AND RADIOMETRIC CONTROL OF AEROSOLS OF LONG HALF-LIFE RADIOACTIVE ISOTOPES IN WORKING PREMISES. Bolotin, V. F.; Tshutkin, O. A. (State Committee on Atomic Energy, Moscow). pp B.8.1-B.8.9 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The question of the evaluation of the internal irradiation of a worker subsequent to the entry in his organism of radioactive isotopes through the respiratory channels can be solved, in our point of view, with the assistance of the following means of control: Uninterrupted control of the entry of the inhaled fraction of radioactive aerosols in the organism; Individual control; Signal indicating the excess above a given value of concentration of radioactive aerosols; Periodical inspection control; Routine measurement of the activity in the organism of the worker; and Scientific research activities in the field of the control of radioactive aerosols. (auth)

21672 EVALUATION OF THE RADIOACTIVE RISK IN RELATION TO SHORT HALF-LIFE AEROSOLS, TO EMANATIONS NOT IN EQUILIBRIUM, AND TO RADIOACTIVE DUST OF LARGE GRANULOMETRY. Badjin, V. I.; Saispina, R. Ia. (Inst. of Biophysics, Moscow). pp C.1.1-C.1.8 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

Two types of evaluation for the risk related to aerosols must be distinguished. The first evaluation is the determination of their role and of their specific part in the total irradiation of the whole group of workers; this leads one to find the qualitative and quantitative characteristics of the contamination of the atmosphere. The second evaluation deals with individual doses of internal irradiation of the workers. If during the first evaluation the average concentrations of radioactive substances in the air are used, for instance when comparing the internal and external irradiation or the conditions of work in two similar laboratories, the second evaluation requires the measurement of the values of individual accumulation of radioactive substances by the workers. At present, the radioactive risk of any kind of irradiation in specified circumstances is determined by the dose of irradiation, that is to say by a basic quantitative characteristic of the harmful effect of this radiation. In order to measure the dose, individual or collective control with the help of dosimeters is used or certain characteristics of the external field or of the contaminated environment are determined with subsequent evaluations of the irradiation doses. The first method is used to determine the dose of external irradiation; the second is more often used for the internal irradiation. (auth)

21673 CLINICAL PEDIATRIC ONCOLOGY. Research Diagnosis Treatment and Prognosis of Malignant Tumors of Childhood. Annual Radiotherapy Symposium, Miami, Florida. Vuksanovic, M. M. (ed.). Mount Kisco, NY; Futura Publishing Company (1972). 199p. $14.75.

Selected topics are presented on the diagnosis, treatment, and prognosis of malignant tumors of childhood. The papers presented are from the annual radiotherapy symposium sponsored by the Cedars of Lebanon Health Center and the Department of Pediatrics of the University of Miami School of Medicine. (ERB)

21674 DELAYED-TYPE HYPERSENSITIVITY AND IMMUNOGLOBULIN LEVELS IN THE COURSE OF CHEMOTHERAPY OF ADVANCED MALIGNANT NEOPLASMS. Singer, Z.; Salwa, J. (Silesian Medical School, Katowice, Poland). Arch. Immunol. Ther. Exp.; 21: No. 2, 239-247(1973).

Tuberculin tests were performed and immunoglobulins were assayed immunoelectrophoretically in 129 patients suffering from malignant neoplasms several times in the course of cytostatic therapy and radiotherapy. It was found, as is known, that delayed-type hypersensitivity is impaired, especially in patients in severe general condition. Tuberculin anergy was more frequent in tumors of lymphatic and reticular organs and in leukemias than in carcinomas. Chemotherapy and radiotherapy impair cellular immunity further. Persistence of positive tuberculin tests or their appearance in patients who were previously negative, as well as strongly positive reactions with a diameter of more than 20 mm, are a sign of good prognosis with regard to immediate therapeutic results. Immunoglobulins exhibited various constellations in tumors, acute leukemia, and malignant lymphogranulomatosis. On the whole, the different fractions tended to increase. In serially examined cases of malignant lymphogranulomatosis and leukemia in the course of cytostatic therapy, various immunoglobulins were not found to be lowered. Low levels of IgG in some patients in the IVth stage of malignant lymphogranulomatosis are not caused by treatment. (auth)

21675 PROBLEMS OF NUCLEAR SAFETY WITH CRITICAL NUCLEAR ASSEMBLIES. Kozlov, V. F.; Chichkin, G. V. (State Committee on Atomic Energy, Moscow). pp D.2.1-D.2.10 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The exploitation of critical assemblies is accompanied by a limited external irradiation to the personnel by neutron and gamma radiations giving doses that are inferior to the maximum permissible doses for professional workers. There is no internal irradiation. In critical assemblies there is always the possibility of a sudden chain-reaction which is dangerous, especially for the workers. Therefore the personnel must be equipped with individual accident dose meters. The further limitation of the radiation danger is also linked to the adoption of measures to eliminate accidents. (BE)

21676 EXPERIENCE WITH THE DUESSELDORF HUMAN BODY RADIATION COUNTER IN PERSONNEL MONITORING IN THE MEDICAL PROFESSIONS. Erlenbach, H. (Gewerbeaufsicht des Landes Nordrhein-Westfalen, Duesseldorf). pp 621-625 of Radioisotope in Pharmakokinetik und Klinischer Biochemie. Hoffmann, G. (ed.). Stuttgart; Schattauer (1970). (In German).

From 6th annual meeting of the Society for Nuclear Medicine; Wiesbaden, Germany (26 Sep 1968).

Investigations on personnel in the medical professions which, due to a lack of appropriate mandatory regulations did not cover all persons involved and were not carried out at regular intervals, were intended as a first step towards a regular incorporation control and the results nevertheless show that: incorporations entailing an internal radiation exposure that is worth measuring occurred mainly in the handling of ^{131}I, in some cases also in the handling of ^{3}H and ^{203}Hg. All other measurements were valuable inasmuch as

they revealed inadequate working methods in the handling of radioactive substances. (GE)

21677 HEALTH PHYSICS ASPECTS OF THE USE OF THORIUM. van der Lugt, G. (Keuring van Electrotechnische Materials, Arnhem, Netherlands). pp C.3.1-C.3.5 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

In the nuclear laboratory of the KEMA in Arnhem, where the Kema Suspension Test Reactor (a thorium thermal nearbreeder reactor) is being developed, much work is done with thorium. Particles with a range of diameters between 0.01 μm and 5 μm consisting of a ThO_2-UO_2-mixture (ratio Th/U about 5) are fabricated and used for experiments. Dry powders of these particles can give considerable air contaminations and as a consequence internal contaminations of the workers. In this paper some measuring techniques are discussed, which are used to detect dangerous situations as soon as possible. One of the most important ways for internal contamination with thorium is by inhalation of contaminated air. The clearance from the lung of ThO_2 particles is quite slow, so that the lung is the critical organ. A combination of two measurements is used in our laboratory for the determination of the internal contaminations with natural thorium: measurement of thoron concentration in breath; and measurement of the γ activity in the body of some members of the thorium series with a whole-body counter. The waste water of the nuclear laboratory of the KEMA is discharged in the Rhine in batches of about 20 m^3 after measurement of the activity concentration of the water of each batch. The concentration is measured with a 35 mm × 35 mm NaI (Tl) crystal, built in a sturdy watertight housing and immersed in a 3.2 m^3 tank. The connected ratemeter gives a recording on a paper strip and an alarm when a preset level is exceeded. In that case the discharge pump stops. (auth)

21678 GONADAL AND LENS DOSES TO THE PATIENT AND EXAMINER DURING ANGIOGRAPHY OF THE LOWER HALF OF THE BODY, USING A METAPHOSPHATE GLASS DOSIMETER (RENAL ANGIOGRAPHY, ARTERIOGRAPHY OF THE PELVIS, AND EXTREMITIES). Schmitt, G.; Ewen, K.; Teske, H. J. (Ruhr-Univ., Essen). Fortschr. Geb. Roentgenstr. Nuklearmed.; 117: No. 6, 674-680(Dec 1972). (In German).

The gonadal dose to the patient and to the examiner, and the lens dose to the examiner, were determined during arteriograms of the abdomen (kidneys and pelvis) and of the lower extremities. Average gonadal dose to the patients was as follows: Renal arteriogram Men: 40 mR, Women: 43 mR; Peripheral arteriograms Men: 550 mR, Women: 94 mR; and Pelvic arteriograms Men: 290 mR, Women: 1,110 mR. Average gonadal dose to the examiner wearing a 0.25 mm lead equivalent apron for all three types of examination was about 1 mR, average lens dose about 30 mR. The high lens dose can be reduced by a factor of 20 by simple protective measures. (auth)

21679 PRINCIPLES FOR THE DETERMINATION OF THE WORKING TOLERANCE LEVELS IN RELATION TO THE COEFFICIENTS OF THE EXISTING RADIOACTIVE SITUATIONS IN PROFESSIONAL CIRCUMSTANCES. Badjin, V. I.; Sayapina, R. Ya. (Inst. of Biophysics, Moscow). pp A.2.1-A.2.5 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The principles for evaluating the tolerance limits of irradiation indexes by evaluating for example the concentrations of radioactive aerosols in the atmosphere of the working environment were studied. A criterion of safety based on the necessity that the average (in space and in time) concentration does not overpass the value MPC was used. The average concentration $\bar{c}$ has a collective character and is applicable equally to all the people working in the considered premises, supposed to remain during an equal time of exposure in conditions of mean concentration, because when $\bar{c}$ is calculated the necessary determination of the time spent in the contaminated atmosphere is lacking. The study of the law of distribution of the values of individual intake and accumulation of radioactive substances, individual doses of external irradiation of the workers, and also concentration of radioactive aerosols in the working premises chosen has shown that such distributions follow a normal logarithmic law. The normal logarithmic law of distribution remains if a shift is made from secondary characteristics to primary, for instance from the concentration of radioactive aerosols in the air to the values of intake and accumulation of radioactive substances in the organism of the workers. As a consequence, the concentration of the radioactive aerosols averaged in space and time cannot be ascribed equally to each individual working in a given premises. In the case of normal logarithmic distribution of dosimetric characteristics, the equality of the averaged index to the permissible value does not guarantee the safety of every individual and by consequence not of the group as a whole. (auth)

21680 NATURAL RADIATION BURDEN. Schraub, A. (Univ., Giessen, Ger.). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

A comprehensive survey is given on the distribution of natural radioactivity in the biosphere, the resulting external and internal radiation of the population, and on new knowledge of radiation effects and radiation protection. (GE)

21681 USE OF PROTECTIVE SHIELDING IN CHILDREN IN THE LIGHT OF DOSIMETRIC MEASUREMENTS. Kubicz, S.; Musialowicz, T. Pol. Przegl. Radiol. Med. Nukl.; 37: No. 3, 411-420(1973). (In Polish).

The effectiveness of gonadal shielding against ionizing radiation was determined using Omniprot, Thyreoprot, and a protecting bridge designed by one of the authors. Measurements were done with a Victoreen 570 dosimeter with chambers with measurement ranges 0.5 to 25, 5 to 250, and 200 to 10,000 mR. Omniprot decreased the intensity of the radiation by 50% at a distance of 10 cm from the border of the irradiated field the size of 24 × 30 cm in the opening of the phantom, and 25 cm from the border of the field irradiated beside the phantom with an exposure performed at a distance of 150 cm and 70 kV voltage. Thyreoprot decreased the intensity of the radiation by 88% in the area of the thyroid during radiograms of incisors done with Stomax dental x-ray unit at a voltage of 60 kV. The protecting bridge decreased the intensity of the radiation by 15% at a distance of 10 cm from the border of the irradiated field the size of 24 × 30 cm in the opening of the phantom corresponding to the location of female gonads, by 57% at a distance of 25 cm from the border of irradiated field outside the phantom with an exposure at a distance of 100 cm and voltage 70 kV. The exposures were done using a Contrastor 150 X-ray unit Medicor: for determination of the efficiency of Omniprot at a distance of 150 cm using a deep diaphragm of DDR production; for determination of the efficiency of protection of the protecting bridge at a distance of 100 cm with a Medicor deep diaphragm. Similar results of determinations of the effectiveness of protection provided by the protecting bridge were obtained under similar conditions during exposures carried out with an x-ray unit Televix of Belgian production with a deep diaphragm of the same firm. Determinations of effectiveness of additional shielding, protecting bridge with and without phantom, permit the intensity of dispersed radiation developing in phantom or the body of the patient to be evaluated. (auth)

21682 CUTANEOUS EPITHELIOMAS IN PATIENTS LESS THAN 40 YEARS OLD. Marchac, D. (Hospital Saint-Louis, Paris). Nouv. Presse Med.; 1: 3035-3039(16 Dec 1972). (In French).

Thirty-five patients aged under 40 with skin epitheliomas seen on Professor Dufourmentel's unit are reported. They were mainly basal cell epitheliomas of the face. These lesions may be primary in half the cases, and suggest special skin sensitivity, perhaps to sunlight, as there often exist multiple epitheliomas, or secondary, in particular on retractile scars and in radiation dermatitis following radiotherapy for an angioma. Surgical treatment is recommended and is the method of choice. Removal should be sufficiently large, even in young women. In the series studied here, out of 35 cases, there was one relapse at 2 yrs and one at 4 yrs. (auth)

21683 DETERMINATION OF RADIOLOGICAL EFFECTS OF THE ACCIDENTAL RELEASE OF RADIOACTIVE FISSION PRODUCTS INTO THE ATMOSPHERE FROM NUCLEAR FACILITIES, PARTICULARLY NUCLEAR POWER PLANTS. 1. Literature Study on the Dose Dependent Effects of Ionizing Radiation on the Human Organism. Dick, C.; Kvasnicka, J. V. Cologne; TUEV Rheinland (1973). 146p. (In German).

As examples for the radiation effects due to fission product release from nuclear facilities, acute radiation syndrome, radioinduced cataracts, and an increase of the frequency of thyroid carcinomas due to irradiation are treated. The dose-dependence of these radiation effects are numerically estimated from literature data. Validity and reliability analyses of the derived dose-effect relations were performed. (GE)

21684 RADIATION DOSE RECEIVED BY PERSONNEL DURING RADIOLOGICAL DIAGNOSTIC PROCEDURES; CURRENT CRITERIA FOR ITS EVALUATION. Ewen, K.; Schmitt, G.; Heissen, E. (Gewerbeaufsicht des Landes Nordrhein-Westfalen, Duesseldorf, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed.; 118: No. 6, 715-720(1973). (In German).

Measurements of secondary radiation during radiological diag-

nostic procedures are difficult because of the continuously varying amounts of radiation and their geometry. Consequently, very few authors have given figures to indicate the radiation dose received by personnel. In particular, no practical methods are available for measuring integral bone marrow dose in the personnel; this would be particularly valuable for estimating damage to the leucocyte series. Current radiation protection recommendations and regulations have reduced the risk considerably. At present, a realistic estimate would seem to be one to two rem/y as the genetic and somatic (trunk) dose received by a radiologist, assuming satisfactory radiation pion protection. Assuming these values, it is unlikely that dosage of ten to twenty rem, which may be genetically damaging, will be received by a radiologist within a generation. (auth)

21685 AGE-SEX SPECIFIC ACHILLES TENDON REFLEX TIME IN JAPANESE: A STUDY OF ATOMIC BOMB SURVIVORS, HIROSHIMA. Omori, Y. (Atomic Bomb Casualty Commission, Hiroshima); Ashley, F. W.; Belsky, J. L. J. Chron. Dis.; 25: 111-120(1972).

Achilles tendon reflex, in normals, was studied with the photomotograph on 2100 (ages 18 to 89 yr) atomic bomb survivors and nonexposed controls of the Atomic Bomb Casualty Commission in Hiroshima to delineate effects of A-bomb radiation and aging. The reflex time was significantly prolonged, progressively, with age and it was more delayed in females than in males. The mean tap-to-half relaxation time was 290 ± 40 msec in males (mean age 46) and 321 ± 49 msec in females (mean age 46), which are similar to figures reported previously in Europe and the United States. In relation to radiation and obesity, no statistically significant difference in reflex time was found. These studies suggest that neurologic components of the reflex arc may be resistant to delayed effects of A-bomb radiation. Problems in interpreting reflex tracings and on differences in reflex time among races are discussed. Attention is called to age as an extrathyroidal factor in affecting achilles tendon reflex. (auth)

21686 ETIOLOGY OF HUMAN CHROMOSOME ABERRATIONS. Dezso, S. Orv. Hetil.; 114: No. 16, 907-914(22 Apr 1973). (In Hungarian).

The literature (100 references, largely English language) on chromosome aberrations, including chemically induced and radio-induced changes, is reviewed. (TTT)

21687 COAGULABILITY AND FIBRINOLYSIS OF BLOOD IN PATIENTS WITH RADIATION-INDUCED ULCERS OF THE SKIN. Bardychev, M. S.; Chekalina, S. I.; Byrikhin, V.I. Med. Radiol.; 18: No. 7, 81-84(1973). (In Russian).

The coagulability and fibrin activities of blood were studied in 65 patients, 13 to 76 yrs old, who were given radiation (x and gamma) therapy and subsequently developed skin ulcers. In all patients the fibrinase activity was much higher than in the controls, as was also the stability of the fibrin clot to plasmin and the concentration of fibrinogen. At least one index increased in all patients, and all six indexes tested (thrombotest, plasma tolerance to heparin, fibrinogen B in the circulating blood, etc.) increased in 75% of them. Nicotinic acid should be given to such patients, and the localized use of heparin and proteolytic enzymes is recommended. (17 references) (TTT)

21688 RADIOPROTECTING PROPERTIES OF BENZOFURAN DERIVATIVES. Frossard, H. (Centre de Recherches du Service de Sante des Armees, Clamart, France); Fatome, M.; Royer, R.; Lechartier, J. P.; Guillaumel, J.; Demerseman, P. Chim. Ther.; 8: No. 1, 32-35(Jan 1973). (In French).

Several 6-acylated 2,3-dimethyl-4,7-dihydroxybenzofuran derivatives as well as several corresponding dimethyl ethers possess interesting radioprotecting properties. These properties justify pharmacological studies of the benzofuran series. (FR)

21689 FRACTION OF RED, ACTIVE MARROW IN THE UPPER END OF THE HUMAN FEMUR. Dyson, E. D. (National Radiological Protection Board, Harwell, Eng.); Whitehouse, W. J. Health Phys.; 25: No. 2, 186-188(Aug 1973).

Ellis (Phys. Med. Biol.; 5: 255 (1961)), in computing the amount of active bone marrow in the adult, uses a fraction 0.75 (75%) for the proportion of the marrow in the head and neck of the femur which is active. Results of work on the proximal ends of femurs of two young healthy adults are given and indicate that this value may be too high. Definitive conclusions cannot be drawn at this stage, but both the male femur and the female femur which were examined are exceptions to the accepted rule. In only one small area was red marrow found to predominate; in all other regions the relative area of red marrow was 26% or less. (UK)

21690 ^{3}H-THYMIDINE-TEST FOR ASSESSMENT OF RADIOSENSITIVITY OF CANCER OF THE UTERINE CERVIX. Fettig, O.; Kaltenbach, F. B.; Kloke, W. D. (Univ., Frieburg i. B.). Arch. Gynaekol.; 213: No. 3, 283-292(1973). (In German).

From sixth academic meeting of German-speaking professors for tocology and gynaecology; Lucerne, Switzerland (4 Oct 1971).

An autoradiographic technique was used for the determination of the radiosensitivity of the squamous epithelium cancer of the uterine cervix. From 30 patients, a needle biopsy of the tumor tissue was taken before beginning the therapeutic irradiation and on the 10th day after they had got a total dose of 1,500 R. The biopsy material was labeled with ^{3}H-thymidine and the labeling index was determined by means of the deeping method. According to the observed changes of the index, a prognosis of the further course was tried that showed a 78% correspondence to the clinical observed course. Because of this high correlation and because of the simple performance and the high prognostic significance, the ^{3}H-thymidine test seems to be a suitable method for early selection of therapy and therefore for prophylaxis of recurrence. (GE)

21691 PHYSICAL VIEWPOINTS OF DEEP THERAPY USING ELECTRONS AND X RAYS UP TO 50 MeV. Fehrentz, D. (Univ., Heidelberg). Electromedica; 41: No. 2, 68-79(1973). (In German).

.The suitability of x rays and electron radiation up to 50 MeV for irradiation of deep-lying tumors was investigated. Integral dose and surface dose as well as the effect of tissue inhomogeneity were compared. Electrons over 20 MeV proved to be more advantageous than other types of radiation. The upper limit, due to anatomical structural conditions, of the electron energy applicable was between 40 and 50 MeV. For x radiation, there are slight improvements in the region 20 to 50 MV, favoring the higher energy. (GE)

21692 PERICHONDRITIS OF THE LARYNX AFTER IRRADIATION. Theissing, J.; Jung, H. (Univ., Mainz). Arch. Klin. Exp. Ohren-, Nasen- Kehlkopfheilk.; 201: No. 4, 324-331(1972). (In German).

Larynges that had received radiation treatment and were subsequently resected in toto were subjected to histological examination. In some of them, there had been clinical signs of a perichondritis, either caused by the tumor or due to the x rays. Histologically, there were invariably regressive changes of the cartilage and the submucosal layer. In those cases in which there had been clinical signs of perichondritis, however, inflammatory changes were found over wide areas. It is therefore felt that the dystrophic changes in the cartilage and the perichondritis are not one and the same thing, although both of them are caused by the x-ray treatment. The perichondrium plays an important role in the spread of pathology. (auth)

21693 EXPERIENCE WITH NEW EMULSIONS AS A PROPHYLACTIC MEANS AGAINST THE SO-CALLED RADIODERMATITIS. Moayer, M. (Univ. Bochum, Essen, Ger.). Radiologe; 13: No. 2, 80-81(1973). (In German).

A double placebo test with 65 patients, carried out separately for each side of the body, clearly demonstrated that the application of a creme described as ambiphile will prevent the occurrence of a radiodermatitis. The application of the same creme with an addition of 0.1% of a corticoid did not show better results. Hence it can be said that corticoid-containing topicals should not be used for the prevention of skin reactions due to long-term radiotherapy. The advantages of high-voltage therapy are pointed out. (GE)

21694 POPULATION HETEROGENEITY HYPOTHESIS ON RADIATION INDUCED CANCER. Baum, J. W. (Brookhaven National Lab., Upton, NY). Health Phys.; 25: No. 2, 97-104(Aug 1973).

From 16th annual meeting of the Health Physics Society; New York (12 Jul 1971).

Analyses of dose-effect relations for radiation-induced tumors and cancers in Drosophila, mice, rats, and man reveal that increase in incidence can often be represented by a simple power function of dose. The exponent depends on genetic factors, type of cancer, radiation quality, dose rate, etc. An important observation is that the exponent is frequently less than 1.0 for carcinogenesis in man. The proposed explanation for this is based on the fact that man is a heterogeneous population with mixed predisposition to cancer due to genetic differences, and sensitivity that varies with age, sex, environmental factors, cell type, stage of cell cycle, etc. At low doses, those fractions of the population that respond according to one-target kinetics tend to dominate the dose-effect relationship. In a mixed population, the most sensitive sub-group responds at the lowest dose and causes a steep slope in this portion of the dose-effect curve. At higher doses the less sensitive sub-groups become dominant with consequent reduction in slope of the dose-effect curve. The resultant curve can be convex upward. Hence, greater effects might be observed at low doses than would be predicted by linear extrapolation from higher doses. Thus, the assumption of a linear nonthreshold relationship used by standards setting groups is not necessarily conservative in estimating cancer risk at low doses. (auth)

21695 BUILD-UP AND BUILD-DOWN MEASUREMENTS WITH THIN LiF TEFLON DOSIMETERS WITH SPECIAL REFERENCE TO RADIO THERAPY OF CARCINOMA OF THE LARYNX. Koskinen, M. O.; Spring, E. (Univ. of Helsinki). Strahlentherapie; 145: No. 5, 565-570(1973).

LiF–Teflon dosimeters, 20 to 28 μm thick, were employed in the study of build-up and build-down effects in a phantom simulating the upper respiratory air passages. The results obtained indicate decrements to 7% in the build-up, and to 6% in the build-down regions of the interface of the air cavity and the phantom. The importance of these results for the treatment of carcinoma of the larynx is discussed. (GE)

21696 RADIOBIOLOGICAL BASIS OF THE THERAPY OF LEUKEMIA. Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). (1973). vp. (In German).

From 79th meeting of Deutsche Gesellschaft fuer Innere Medizin; Wiesbaden, Germany (29 Apr 1973).

The radiobiological basis for the limitations of radiotherapy of leukemia is reviewed. These limitations are serious, and this is why chemotherapy and perhaps also immunotherapy will be preferred for the treatment of leukemia. Nevertheless, radiobiological investigations have opened up new methods and have led to the definition of some principles of the physiology of cell systems that proved to be of great importance in the chemotherapeutical approach. Such concepts as the quantitative determination of the extent of cell killing and the knowledge and use of the varying sensitivity of cells during the different phases of the cell cycle, and the insight gained into recovery mechanism of normal body tissue, which can be taken into account in the therapy, are the outcome of radiobiological studies. Although these findings have by no means solved the problems encountered in the search for appropriate and effective therapeutic measures, radiobiological studies have helped scientists to gain a little ground in their battle against leukemia. (GE)

21697 WE ARE BEING FOOLED BY THESE GENETICALLY SIGNIFICANT DOSES FROM DIAGNOSTIC X RAY. Pretre, S. (Nuclear Installations Safety Division, Wuerenlingen, Switzerland). Health Phys.; 25: No. 2, 201(Aug 1973).

It is stated that the genetically significant dose is only weakly influenced by chest examinations that comprise about half of all diagnostic x-ray examinations. When the average dose due to medical diagnostic techniques is quoted (about 40 mrem/yr), only the genetically significant dose is referred to, while the true chest dose is around 300 mrem/yr. Until some years ago, the genetic dose was considered to be the most limiting dose. This might not be true anymore. Radiobiologists say now that the genetic risk was overestimated while the risk for cancer incidence was underestimated. Now it is possible that the late somatic effects might well be more limiting than the genetic effects. Thus, a cancer-significant dose should be defined and calculated. (UK)

Vertebrates

Refer also to abstract 21504.

21698 (COO-3085-24) REGULATIONS OF ENZYMES IN ANIMALS: EFFECTS OF DEVELOPMENTAL PROCESSES, CANCER, AND RADIATION. Progress Report VII, 1 May 1972–30 April 1973. Knox, W. E. (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). Jun 1973. Contract AT(11-1)-3085. 18p. Dep. NTIS $3.00.

Controls by genes and by adaptive phenomena of the patterns of enzymes in several rat tissues were extended by systematic investigations during development, in neoplasms, and after exposure to x radiation. Patterns of enzymes quantitatively measured in a variety of tissues have been accumulated in sufficient number to demonstrate several orderly relationships among rat tissues. These include the greater chemical similarities among undifferentiated fetal tissues than among differentiated adult tissues, the greater chemical similarities among undifferentiated tumors than among their differentiated tissues of origin, and the similarities between tumors and fetal tissues. (CH)

21699 (COO-3380-10) TUMORIGENIC ACTION OF BETA, PROTON, ALPHA, AND ELECTRON RADIATION ON RAT SKIN. Progress Report, August 1, 1972–July 31, 1973. Albert, R. E.; Burns, F. J. (New York Univ., N. Y. School of Medicine). 1973. Contract AT(11-1)-3380. 22p. Dep. NTIS $3.25.

A biological model was developed for the prediction of tumor incidence in irradiated rat skin as a function of LET, radiation dose, dose rate, dose fractionation schedule, and biological recovery rate. Data are included from studies on: the critical depth for radioinduced tumors in rat skin in relation to the growth phase of hair follicles following exposure to surface doses ranging from 500 to 3000 rads; the effect of postirradiation cell proliferation on tumor incidence; the relation of high-LET radiation dose fractionation schedule to tumor induction; and the effects of methotrexate-induced cell death on the incidence of radioinduced tumors in rat skin. A technique was developed for the microscopic detection of very small tumors in excised rat skin following staining of the DNA in cell nuclei. (CH)

21700 EFFECTS OF NITROGEN MUSTARD ON THE SURVIVAL OF MURINE HEMATOPOIETIC STEM CELLS. Ash, R.; Chaffey, J. T.; Hellman, S. (Harvard Univ., Boston). Cancer Res.; 32: 1695-1702(Aug 1972).

The effects of nitrogen mustard on murine hematopoietic stem cells are reported. The data indicate no evidence for intracellular repair of sublethal nitrogen mustard damage. The survival characteristics of cells at different positions of the cell cycle are different, with late S and G_2 cells being most resistant, and G_1 being most sensitive. The survival curve of hemopoietic stem cells can be resolved into a mixture of two populations of cells with different exponential survival characteristics. For the determination of survival of proliferating colony-forming cells, x-irradiated mice were given injections of bone marrow cells and then given graded doses of nitrogen mustard. Eight days later the recipients were killed and survival fractions were determined. Graphs are presented to show results. (HLW)

21701 ENAMEL HYPOPLASIA OF THE DECIDUOUS INCISOR TEETH OF A CALF. West, J. L. (Univ. of Tennessee, Oak Ridge). AT(40-1)-GEN-242. Amer. J. Vet. Res.; 34: No. 6, 839-840(Jun 1973).

Abnormal deciduous incisor teeth were found in a calf produced by a Hereford dam that had been irradiated with ^{60}Co gamma rays (total exposure of 350 R at 50 R per minute) on the 128th day of gestation. Extensive hypoplasia, discoloration, and erosion of the enamel were bilaterally symmetrical. Change was not apparent in the dentine. The cheek teeth were essentially normal. Two other fetuses similarly exposed in utero had less severe deciduous incisor enamel changes. (CH)

21702 EARLY CHANGES IN THE FUNCTIONAL VASCULATURE OF WALKER CARCINOMA 256 FOLLOWING IRRADIATION. Wong, H. H.; Song, C. W.; Levitt, S. H. (Univ. of Minnesota, Minneapolis). Radiology; 108: No. 2, 429-434(Aug 1973).

Early vascular changes in Walker carcinoma 256 of rats were studied following x-irradiation with doses of 250 to 2,000 rads and at intervals of 6 to 36 hours. It was found that 250 rads produced only a transient decrease in vascular volume and increased permeability. As the dose was increased, vascular volume continued to decrease, accompanied by significantly elevated levels of plasma protein extravasation, which were interpreted as a sign of severe endothelial damage. Monitoring vascular changes to indicate loss of endothelial integrity may be helpful in establishing new time-dose relationships. (auth)

21703 PATTERNS OF PULMONARY ALVEOLAR MACROPHAGE FUNCTION FOLLOWING RADIATION INJURY. Goldstein, E.; Lewis, J. P. (Univ. of California, Davis). J. Lab. Clin. Med.; 82: No. 2, 276-286(Aug 1973).

The effect of lethal x-irradiation (875 R) on pulmonary antibacterial defense mechanisms was assessed in syngeneic mice by simultaneously measuring physical removal and intrapulmonary bacterial killing rates following the inhalation of ^{32}P-labeled Staphylococcus aureus. Mice that were lethally irradiated died in 10 to 14 days and had small defects in bactericidal function prior to death. Mice that were treated with 2.0×10^6 bone marrow cells survived and had equivalently small defects in bactericidal activity at 10 days after irradiation. Much more severe defects in intrapulmonary bacterial killing were present at 21, 35, and 60 days. Additional studies were performed at day 21 in mice that were protected from the lethal irradiation with a smaller graft of 5×10^4 cells, or a chest or pelvic shield. The defect in bactericidal function was abolished by the chest shield, but was not altered by the size of graft or the pelvic shield. Marrow transplants may prevent radiation lethality by protecting systems other than those involved in pulmonary defenses, whereas the protective effect of shielding the chest (unlike shielding the pelvis) is consistent with an intrapulmonary source of alveolar macrophages. (auth)

21704 EFFECT OF IRRADIATION ON THE RELEASE OF LYMPHOCYTE ACTIVATING FACTOR (LAF). Geiger, B.; Gallily, R.; Gery, I. (Hebrew Univ., Jerusalem). Cell. Immunol.; 7: 177-180(Apr 1973).

Peritoneal macrophage cells from whole-body x irradiated mice released two to three times more lymphocyte-activating factor (LAF) than did the cells from untreated controls. Similar results were obtained with unfractionated or enriched ad-

herent cells. On the other hand, irradiation of adherent cells in vitro did not affect the level of factor released. (auth)

21705 EFFECTS OF RADIATION ON HEMATOPOIETIC TISSUE DISC SUSCEPTIBILITIES TO FOUR TETRACYLINES. Trobaugh, F. E. Jr.; Husseini, S. Amer. J. Med. Technol.; 39: No. 4, 119-131(Apr 1973).

Hematopoietic tissue is characterized by a rapid rate of cell renewal, which constantly replenishes the functional, nondividing cells of the blood. This cell renewal system of mammals starts with a reservoir of undifferentiated precursor cells, hematopoietic stem cells, which constantly feeds differentiated precursor cells into the dividing and maturing pool of the bone marrow while maintaining the numbers of stem cells. Radiation damages the hematopoietic system by killing stem cells. These cells are highly radiosensitive whereas mature functional blood cells are radioresistant. Following sublethal radiation, colonies of proliferating hematopoietic cells develop from endogenous stem cells. Animals can be protected from lethal radiation by transplantation of suspensions of hematopoietic cells from other animals. Such transplantation can be effective if the immune reaction between the host's cells and the graft's cells can be avoided or controlled. (auth)

21706 MODIFICATION OF SEVERE GRAFT-VERSUS-HOST DISEASE WITH ANTISERA TO THE THETA ANTIGEN OR TO WHOLE SERUM. Tyan, M. L. (Dental Research Center, Chapel Hill, NC). Transplantation; 15: No. 6, 601-604(Jun 1973).

Lethally irradiated mice were given allogeneic bone marrow and spleen cells untreated or after incubation with AKR anti-θ C3H or rabbit antimouse sera and complement. The acute or fulminating graft-versus-host (GVH) disease produced by the untreated allogeneic cells was greatly reduced by the two treatment modalities. (auth)

21707 UNSCHEDULED SYNTHESIS OF DNA DURING MAMMALIAN SPERMATOGENESIS IN RESPONSE TO UV IRRADIATION. Gledhill, B. L.; Darzynkiewicz, Z. (Univ. of Pennsylvania, Philadelphia). J. Exp. Zool.; 183: 375-382(Mar 1973).

Unscheduled incorporation of tritium-labeled thymidine into nuclear DNA, induced by uv irradiation and presumed to indicate DNA repair replication, has been followed in differentiating male germ cells of the rat and rabbit by quantitative autoradiographic techniques. Cells at various stages of differentiation incorporated [^{3}H] thymidine at different rates. The maximal rate was observed in nuclei of pachytene primary spermatocytes; the rate was markedly lower in spermatogonia and in leptotene and zygotene primary spermatocyte nuclei. No evidence of incorporation was found for nuclei of spermatids and testis spermatozoa. (auth)

21708 CORRELATION BETWEEN CYTOKINETICALLY RESTING LYMPHOCYTES AND BONE MARROW RESTORATION: EXPERIMENTS USING A DISCONTINUOUS ALBUMIN GRADIENT. Hass, R. J.; Flad, H. D.; Fliedner, T. M.; Fache, I. (Univ. of Ulm, Ger.). Blood; 42: No. 2, 209-218(Aug 1973).

Rats were labeled with ^{3}H-thymidine (^{3}H-TdR) in utero and for 6 wk after birth in order to obtain 100% labeling of all bone marrow cells. Six weeks after the last ^{3}H-TdR injection only cytokinetically resting cells were still labeled. At this time, the regenerative capacity of fractions obtained after centrifugation on a discontinuous albumin gradient was tested in 1200 R x-irradiated recipients, and the results were compared with the effect observed after transplantation of the same number of unfractionated bone marrow cells. One of the fractions obtained had a regeneratory capacity tenfold that of unfractionated cells. In contrast, when the response to a PHA stimulation test was evaluated, this fraction showed a decreased incorporation of ^{14}C-TdR as compared to other fractions. In a second test system, fractions of bone marrow from ^{3}H-TdR-labeled donors made hypoplastic by repeated injections of hydroxyurea were transfused into 1200-R x-irradiated recipients. Regenerative capacity was similar to that seen in the first experiment. The findings indicate a correlation between cytokinetically resting, small mononuclear cells and the regeneratory process in lethally x-irradiated recipients. (auth)

21709 INJURY OF MUCOSA EPITHELIUM OF THE ORAL CAVITY FOLLOWING IRRADIATION OF THE HEAD. Afrikanova, L. A.; Izmailova, G. M.; Shikhodyrov, V. V. Med. Radial.; 18: No. 7, 19-25(Jul 1973). (In Russian).

Using a model of oral radiation syndrome in mice a study was made of the morphogenesis of mucosa injury of the oral cavity. It was established that under the conditions of hard x-ray radiation the epithelium of the tongue possessed the greatest radiosensitivity where a dose of 200 R in 100% of the cases caused irreversible disorders in the processes of regeneration. The development of ulcers of the mucosa in different regions of the oral cavity was caused by the postradiation atrophy of the epithelium and radiation injuries to lymphoepithelial formations of the pharynx. (auth)

21710 RADIATION-INDUCED ABERRATIONS IN ANEUPLOID VS. DIPLOID SWINE LEUKOCYTES. McFee, A. F.; Sherrill, M. N.; Banner, M. W. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-Gen-242. Mutat. Res.; 18: No. 3, 311-314(Jun 1973).

Swine leukocytes were cultured for 48 h after receiving γ exposures up to 400 R. Cells with one or two less than the diploid number of centromeres consistently contained more chromosome deletions than did diploid cells. This effect was not evident for dicentric and ring aberrations. Both aneuploid frequencies and the proportion of aberrations in aneuploid cells increased in irradiated samples but showed no dose-response relationship. (auth)

21711 ALTERATION OF THE SERUM AND LIVER LIPID FRACTIONS IN THE RAT AFTER LOCAL LIVER IRRADIATION WITH 4000 R. Gottwald, G.; Soltesz, L. Magy. Radiol.; 25: No. 3, 157-159(1973). (In Hungarian).

No significant alteration was found in either serum lipid fraction in the first 7 days after irradiation. During this time a reversible decrease of the liver's cholesterin content was observed. No alteration occurred in the liver's phospholipid and esterified fatty acid fraction either. The decrease of the liver cholesterin developing in the 72nd hr after the irradiation points to the organ's direct damage. (auth)

21712 PROTECTIVE EFFECT OF ACETYLBENZOYLACONINE AGAINST GAMMA RADIATION. Moon, P. S. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 83-86(Jun 1973).

The protective effects of acetylbenzoylaconine, 2-aminoethylisothiuronium bromide hydrobromide, β-mercaptoethylamine HCl, and L-thiazolidine-4-carboxylic acid were studied on the white male mice, aged 5 to 6 weeks. The toxicity test of acetylbenzoylaconine revealed that the LD_{50} was 2.5 mg/kg of body weight. After the administration of test substances, mice were irradiated with a whole-body dose of 800 rad ^{60}Co γ radiation. After observing the number of surviving mice for 30 days, the survival coefficients for the test groups were calculated and with these the protective coefficients against radiation injury, PCR, were also calculated. The PCR values were 2.24, 2.95, 2.78, and 1.23 for acetylbenzoylaconine, 2-aminoethylisothiouronium bromide hydrobromide, β-mercaptoethylamine HCl, and L-thiazolidine-4-carboxylic acid, respectively. These values reveal that the acetylbenzoylaconine has protective potency against radiation injury on white male mice. (auth)

21713 OSMOTIC RESISTANCE CHANGES IN MOUSE ERYTHROCYTES UNDER THE INFLUENCE OF X RADIATION AND RADIOPROTECTIVE COMPOUNDS. M. Ferenczy; Santha, A.: Mandi, E. Honvedorvos; 25: No. 1, 60-63(1973). (In Hungarian).

The osmotic resistance of erythrocytes was experimentally determined in mice. Following x irradiation with 1000 R, the osmotic resistance decreased in vivo. Through the addition of AET, the erythrocyte resistance was enhanced in vitro. In mice irradiated with 1000 R as well as in nonirradiated control animals, the osmotic erythrocyte resistance was increased by AET alone or in combination with cysteine. The findings confirmed the concept that SH-group containing radioprotective agents ameliorated the radioinduced increase in permeability. (tr-auth)

21714 PATHOGENESIS OF PLUTONIUM PNEUMOSCLEROSIS. Koshurnikova, N. A.; Aristov, V. P.; Lemberg, V. K.; Mushkacheva, G. S.; Popylko, M. G.; Tseveleva, I. A. Arkh. Patol.; 35: No. 4, 48-54(1973). (In Russian).

Using fluorescent and electron microscopy and biochemical methods the dynamics of the development of pneumosclerosis following inhalation of soluble compounds of plutonium-239 were investigated. Pneumosclerosis was characterized by extensive fibrosis of the interalveolar septa in combination with foci of the dense connective tissue. Plutonium pneumosclerosis is a manifestation of excessive reparative function of the connective tissue against the background of impaired physiological regeneration and intensified destruction of the lung parenchyma caused by the radiation damage. The endothelium of capillaries was found to be most vulnerable. Interalveolar sclerosis was developed by forming collagenous fibres in the basal membrane of the alveolar-capillary barrier and in the lumina of the former capillaries. (auth)

21715 INFLUENCE OF THYREODINE ON SUBLETHAL IRRADIATION ON THE THYROID GLAND. Amiragov, D. G. Biol. Zh. Arm.; 25: No. 11, 74-77(Nov 1972). (In Russian).

A total of 20 rats were irradiated with a sublethal dose of 500 rad with a Gammacell 220, and ten of these received a daily administration of 5 mg thyreodine. The thyroid glands were extirpated at intervals and their functional activity was measured.

The results indicated that the thyreodine administered tended to remove the hyperplasia of the cells of thyreodine epithelium in the case of animals irradiated sublethally and to change the thyroid gland to a resting state. (KSW)

21716 RADIATION-INDUCED SHIFTS IN THE METABOLISM OF LIPIDS IN THE ORGANELLES OF LIVER CELLS OF THE RAT. Kolomiitseva, I. K.; Kaznacheev, Yu. S.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino-na-Oke, USSR). Dokl. Akad. Nauk SSSR; 209: No. 4, 988-991(1973). (In Russian).

The biosynthesis and transfer rate of choline phosphatide and of ethanolamine phosphatide between substructures of rat liver cells were investigated 1 hr after 1200 R of ^{60}Co gamma radiation. Phosphorus-32-labeled K_2HPO_4 was used to measure the synthesis rates of the phosphatides; e.g., the specific activity of the ethanolamine phosphatide in microsomes and mitochondria of irradiated cells was more than twice that in the controls. The transfer of choline phosphatide between microsomes and subfractions of liver cells fell to 72% after irradiation. (KSW)

21717 CHANGES IN COMPOSITION AND CALORIC DENSITY OF WHOLE BODY HOMOGENATES OF BROILERS EXPOSED TO ACUTE GAMMA RADIATION STRESS. Brisbin, I. L. Jr. (Univ. of Georgia, Athens). Contract AT(38-1)-310. Poultry Sci.; 51: 915-920(May 1972).

Analyses for the major body components of water, fat, and lean dry weight were conducted on whole-body homogenates of thirty 32-day commercial broiler chickens exposed at the age of two days to gamma radiation delivered at 8 R/min. Total exposures ranged from 0 to 900 R. There was no effect of radiation treatment level on water index (gm water/gm lean-dry weight). Fat indices (gm fat/gm lean-dry weight) showed a tendency to peak around the levels of 200 and 700 R. Thirty-two day body weights decreased an average of 22 gm for each additional 100 R exposure. Regression analyses indicated that the average composition of this lost biomass closely approximated that of the biomass of the control birds which contained 67% water, 10% fat, and 22% lean-dry weight. There was no effect of radiation treatment level on the caloric density of the lean-dry biomass. Live-weight caloric density, however, showed a tendency to peak around the 200 R exposure level and undoubtedly reflected changes in the body fat content. (auth)

21718 EFFECT OF IONIZING RADIATION UPON TOTAL DIFFUSE SPECTRAL REFLECTANCE OF ULTRAVIOLET LIGHT BY SKIN. Anglin, J. H. (Univ. of Oklahoma, Oklahoma City). Photochem. Photobiol.; 18: No. 2, 81-85(Aug 1973).

Irradiation of guinea-pig skin with x rays and beta particles resulted in decreased total diffuse reflectance (DSR) of 330 to 400 nm light. Qualitatively, this response resembled that seen after irradiation of the skin of normal guinea pigs with ultraviolet (uv) radiation of wavelength shorter than 300 nm or that of photosensitized guinea pigs with uv wavelengths longer than 300 nm. It is postulated that the transformations that depress the DSR result from energy-transfer processes, independent of the class of radiation. Moreover, they are intimately related to subsequent changes in vascular permeabilities (delayed erythema) that occur after the same radiation exposures that lower the 330 to 400 nm DSR of skin surfaces. (auth)

21719 PREPARING A RADIOISOTOPE PACK FOR PLESIOTHERAPY. A New Technique. Burt, J. K. (Ohio State Univ., Columbus); Johnson, J. H.; Gillette, E. L. Acta Radiol., Suppl.; No. 319, 141-145(1972).

From 2nd international conference of veterinary radiologists; Stockholm, Sweden (1970).

A procedure is described for molding isotopes in needle or bar form for plesiotherapy. The finished pack or mold is pliable and easily conformed to the area being treated. The molded material, with ^{60}Co needles imbedded, has not deteriorated after 3 yrs. The methods employed to confirm isotope placement and radiation distribution are discussed. (auth)

21720 ORAL RADIATION DEATH. Ohba, T. (Kyushu Dental Coll., Fukoka). Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo; 32: No. 8, 667-683(Nov 1972). (In Japanese).

In this investigation of oral radiation death the effects of fifty percent lethal doses 12 days after irradiation ($LD_{50/12}$) and the causes of death were studied. The cranio-facial regions of mice were apportioned into several fields by lead shielding and irradiated using 200 kVp x rays. The $LD_{50/12}$ of each category of irradiation fields was as follows: 2730 ± 140 R for maxillary, 2720 ± 70 R for mandibular, 2340 ± 570 R for maxillary and mandibular, 1890 ± 240 R for maxillary and cerebral, 1900 ± 90 R for mandibular and cerebral, 1890 ± 210 R for maxillary, mandibular, and cerebral, and >5000 R for cerebral. In this investigation, oral radiation death occurred on the 10th post-irradiation day. In an additional study, starvation death generally occurred on the 4th experimental day. The abrupt increase in oral radiation death on the 10th post-irradiation day was probably due to the radiation effect on the oral mucous membrane and a consequent decrease in food intake. In conclusion, starvation secondary to oral radiation damage was the primary cause of oral radiation death. (auth)

21721 EFFECTIVENESS OF FAST NEUTRONS COMPARED WITH LOW LET RADIATION ON CELL SURVIVAL MEASURED IN THE MOUSE JEJUNUM. Hornsey, S. (Hammersmith Hospital, London). Radiat. Res.; 55: No. 1, 55-68(Jul 1973).

Cell survival curves were established from mouse jejunum after irradiation with 6-MeV neutrons at 50 to 100 rads/min from the Hammersmith Cyclotron, 7-MeV electrons at 6 krad/min, and 7-MV x rays at 100 rads/min given in single doses or two fractions. After an initial shoulder region all curves show an exponential region between surviving fractions of 10^{-1} and 10^{-3}. The $LD_{50(3)}$ values for all types of irradiation fall at a cell surviving fraction of 10^{-2}. The relative sensitivities of these radiations obtained from a comparison of D_0 values are for neutrons relative to 7-MV x rays at 100 rad/min 2.0; for neutrons relative to 7-MeV electrons at 6 krad/min 1.5; for 7-MeV electrons at 6 krad/min to 7-MV x rays at 100 rad/min 1.3. The relative sensitivities obtained from a comparison of D_Q values are similarly 4.7, 3.6, and 1.3. Thus, the effect of a change in dose rate in the low LET radiation has almost as big an effect on D_0 as a change in LET but the effect on shoulder size is much less than is seen with a change in LET. (auth)

21722 CELL TRANSFER STUDIES IN CYCLOPHOSPHAMIDE-INDUCED TOLERANCE. Aisenberg, A. C.; Murray, C. (Harvard Univ., Boston). Cell. Immunol.; 7: 143-151(Apr 1973).

Thymectomized, irradiated adult CBA mice were restored with various combinations of bone marrow and thymus cells from nontolerant animals and from animals made tolerant to sheep erythrocytes or to hemocyanin with the drug cyclophosphamide. Mice reconstituted with tolerant marrow and thymus responded as well as those that received nontolerant cells. It was concluded that the tolerant state of the transferred marrow and thymus cells is not a significant factor in the tolerant state of the recipient, and that antigenic diversity is restored in the interaction and proliferation of bone marrow and thymus cells that follow transfer. Thymectomized irradiated mice restored with thymocytes, in contrast to unoperated animals, require multiple antigen injections to demonstrate comparable immune response, but develop tolerance normally when treated with cyclophosphamide and antigen. Reconstitution with tolerant marrow and thymus cells resembles the recovery of immune responsiveness seen after lethal irradiation of tolerant mice; in both instances a complete breakdown of immunological tolerance is observed. (auth)

21723 MULTIPLE BIOCHEMICAL EFFECTS OF A SERIES OF X-RAY INDUCED MUTATIONS AT THE ALBINO LOCUS IN THE MOUSE. Thorndike, J. (Massachusetts General Hospital, Boston); Trigg, M. J.; Stockert, R.; Gluecksohn Waelsch, S.; Cori, C. F. Biochem. Genet.; 9: No. 1, 25-39(1973).

Further studies of the four radioinduced lethal albino mutations causing glucose 6-phosphatase deficiency in the mouse have shown that there is also a deficiency of tyrosine aminotransferase in the newborn albino mutants. These two enzymes can be induced in fetal and newborn heterozygous or homozygous normal littermate controls by injection of glucagon or dibutyryl cyclic AMP, but not in the albino mutants. Microsomal NADH-cytochrome c reductase was found to be increased in the albino mutants. The multiple biochemical abnormalities in the albino mutants, in addition to the lack of gene dosage effect in the heterozygotes, suggest the involvement of genes other than the structural genes for particular enzymes. When a new radioinduced lethal albino mutation was tested against the four original alleles, complementation resulted, and double heterozygotes were found to be viable, with normal enzyme levels. (auth)

21724 AUDIOGENIC SEIZURE SUSCEPTIBILITY OF RATS X-IRRADIATED IN UTERO LATE IN PREGNANCY. Geller, L. M. (Columbia Univ., New York). Exp. Neurol.; 38: 135-143 (Jan 1973).

Sherman strain rats exposed in utero to a maternal whole-body dose of 250 R of x radiation, on Day 17, 18, or 19 of pregnancy, were tested for their susceptibility to sound-induced seizures at a median age of either 256, 266, or 322 days. There was no significant difference among the three prenatally x-irradiated groups or among the control groups, or between any x-irradiated group and its comparably aged control series, or between all x-irradiated animals grouped together and all control animals, in the number of rats displaying running attacks, or seizures, or both. Nor did the latency times (intervals between onset of bell and running attack) of prenatally x-irradiated reactors differ significantly from those of control reactors. No sex difference in susceptibility to sound-

induced running attacks or seizures was found among the irradiated or control animals, or between them. The present findings are in line with and, indeed, complement those derived earlier from similarly treated animals tested for seizure susceptibility at a median age of 21½ months. Apparently, the central neural changes produced in the rat by exposure in utero to maternal x irradiation late in pregnancy, do not collectively predispose or significantly affect the susceptibility of survivors to sound-induced seizures, at least at the ages when this was studied. Data supporting the reliability of some earlier reported age-seizure susceptibility relationships in the normal (Sherman) rat were also noted. (auth)

21725 EFFECT OF THROMBOCYTE-RICH PLASMA ON X-RAY INDUCED BONE MARROW DEATH IN MICE. Nakamura, W. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 55: No. 1, 118-128(Jul 1973).

Thrombocyte-rich plasma, prepared from isogenic unirradiated mice, was intravenously transfused to irradiated mice every day during days 5 to 9 or 12 after irradiation. Thrombocyte-rich plasma administered after x-irradiation showed beneficial effects on survival of mice: 30 day survival increased from 42 to 100% at 708 rads, from 0 to 90% at 755 rads, and from 0 to 26% at 850 rads. No therapeutic effects were observed, however, after injection of streptomycin and penicillin, blood plasma, or thrombocyte-poor plasma, which contained an equal number of erythrocytes and a higher number of leukocytes as in thrombocyte-rich plasma. There were no detectable colony-forming cells in the thrombocyte-rich plasma. (auth)

21726 ELECTROLYTE LOSS, THE MAIN CAUSE OF DEATH FROM THE GASTROINTESTINAL SYNDROME. Gits, J.; Gerber, G. B. (CEN, Mol, Belgium). Radiat. Res.; 55: No. 1, 18-28 (Jul 1973).

Death from the gastrointestinal syndrome after whole-body irradiation is usually thought to result from the loss of electrolytes into the intestine subsequent to the depletion of cells from the villi. Data presented cast doubt on the primary role of electrolyte loss in the G. I. syndrome in rodents. The loss of Na^+ in feces and intestinal tract is less than 10% of the body pool and occurs over the whole postirradiation period. Na^+ diminishes in blood however only during the few hours immediately prior to death concomitantly with a decrease in plasma volume. Replacement therapy with Na^+ (as well as antibiotica, plasmaexpander glucose) does not increase survival time although under these conditions sufficiently Na^+ is kept in the body to cause considerable renal excretion. Na^+ absorption after irradiation is diminished when little Na^+ is present in the lumen but it can even exceed normal Na^+ absorption at high concentrations in the lumen. This behavior is explained by the fact that after irradiation active Na^+ absorption is abolished. No excessive loss of Na^+ into the lumen is observed in perfused intestinal preparations. It is postulated that not electrolyte loss into the intestine but rather changes in permeability in all organs leading to a state of irreversible shock is responsible for death. (auth)

21727 EFFECTS OF MICROWAVE IRRADIATION ON ENZYMES AND METABOLITES IN MOUSE BRAIN. Nelson, S. R. (Univ. of Kansas, Kansas City). Radiat. Res.; 55: No. 1, 153-159(Jul 1973).

After decapitation and exposure of the mouse head to microwave radiation, seven of the eight brain enzymes studied were inactivated. The remaining enzyme, myokinase, retained about 10% of control activity. Brain metabolite levels were also altered by microwave radiation and these changes were used indirectly to obtain information about sensitivity of enzymes to heat inactivation. ATP hydrolyzing enzymes were relatively resistant to heat since inactivation was delayed long enough for half the available ATP to be used. P-creatine kinase was inactivated early during microwave treatment since P-creatine, usually depleted in seconds, was only reduced 30% in the anoxic brain. Hexokinase appeared most sensitive to heat since glucose, rapidly used in the anoxic brain, remained at control levels after microwave irradiation. Glycogen decrease and G-6-P elevation show brain phosphorylase was not immediately inactivated in experimental mice. Low lactate levels in the anoxic, treated brains indicated the flow of glycolytic intermediates was quickly blocked at one or more steps between G-6-P and lactate. Since fructose diphosphate was depleted in brain from the irradiated, anoxic head, aldolase was resistant to early inactivation. The metabolite changes observed after decapitated heads were irradiated were also observed when the heads of intact mice were treated and the changes occurred in both cortex and subcortex of these mice. (auth)

21728 EXPERIMENTAL REORGANIZATION OF THE CEREBELLAR CORTEX. II. Effects of Elimination of Most Microneurons with Prolonged X-Irradiation Started at Four Days. Altman, J.; Anderson, W. J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 149: No. 2, 123-152(May 1973).

The heads of Long-Evans rats were irradiated from the fourth day after birth with a schedule of repeated doses of low-level x-rays, which essentially prevented the formation of basket, stellate, and granule cells in all except the earliest-forming lobules (nodulus and uvula). The morphogenic and synaptogenic effects of this treatment were examined with light and electron microscopy in 30 day old animals, with particular attention paid to the pyramis. Although when irradiation was started the Purkinje cells formed a monolayer and had upward oriented apical poles, they became scattered later and had randomly oriented dendrites. This secondary disorientation was attributed to insufficient space available in the arrested cerebellum for the rapidly expanding Purkinje cells. Although basket cell terminals were scarce, basket cell-like terminals were formed on the somata of Purkinje cells, apparently by recurrent axon collaterals of these cells. The most common synapses with the thorns of Purkinje dendrites were formed by climbing fibers but other elements, including glial processes, were also in contact with postsynaptic loci on the thorns. Many mossy fiber terminals reached the surface. Where parallel fibers were present they were often thicker than in unirradiated animals and contained neurofilaments. No pathological changes were seen in these cerebella, with the possible exception of excessive lobulation of the nuclei of many Purkinje cells. (auth)

21729 DNA SYNTHESIS IN RAT BLASTOCYSTS X-IRRADIATED DURING DELAYED IMPLANTATION. Ward, W. F.; Meyer, R. K.; Wolf, R. C. (Univ. of Wisconsin, Madison). Radiat. Res.; 55: No. 1, 189-196(Jul 1973).

Sprague-Dawley rats were exposed to 300 or 500 R acute whole-body x-irradiation on day 5 of castration-induced delayed pregnancy, and blastocysts were examined at various times thereafter. Both doses of radiation produced a temporary inhibition of mitosis in the embryonic cells. Although mitosis resumed approximately 12 hr after exposure, irradiated embryos failed to grow at a rate comparable to that of sham-irradiated controls. Control embryos attained a maximum size of approximately 85 cells before entering the mitotic dormancy characteristic of delayed implantation in the castrate progesterone-treated rat. Maximum sizes of 71 and 64 cells were attained by embryos exposed to 300 R and 500 R, respectively. Autoradiographic evaluation of [^{3}H] thymidine incorporation revealed a significantly greater percentage of labeled cells in irradiated embryos compared to controls at 2.5 and 5 hr after exposure to either dose. A maximum of 62% of the cells from control embryos incorporated [^{3}H] thymidine during a 1 hr in vitro incubation, whereas 74% of the cells of embryos examined 2.5 hr after 300 R, and 85% of the cells of embryos examined 5 hr after 500 R were labeled. The percentage of labeled cells in irradiated embryos did not return to control levels until 12 hr after exposure, and then tended to fluctuate around control values from 12 to 101 hr after exposure. The data are consistent with the hypothesis that the 12-hr mitotic inhibition observed in the cells of irradiated embryos may be due in part to a prolongation of the time spent in S phase of the cell cycle. (auth)

21730 SITES OF RADIATION SENSITIVITY IN THE VISUAL SYSTEM AS ASSESSED BY DOUBLE LIGHT FLASH. Daugherty, J. H.; Barnes, C. D. (Indiana State Univ., Terre Haute). Radiat. Res.; 55: No. 1, 169-176(Jul 1973).

The effects of 300 R of x-irradiation upon double flash-evoked cortical responses were investigated in the pretrigeminal cat. An inhibition of the primary wave was seen with condition-test intervals up to 200 msec. By alternately conditioning ipsilaterally and contralaterally, a retinal and a lateral geniculate or supraretinal component of the inhibition was discerned. X-irradiation increased the retinal inhibitory component and decreased the lateral geniculate or supraretinal inhibitory component. (auth)

21731 THERMOHEMILUMINESCENCE FOR TISSUE DOSIMETRY. Stavitskii, R. V.; Kozlov, Yu. P.; Sizov, A. D.; Khrolenko, T. G. Med. Radiol.; 18: No. 8, 47-52(Aug 1973). (In Russian).

The possibility of the use of relative thermohemiluminescence in tissue dosimetry is considered. A technique for carrying out investigations, dependence curves, dose-effect curves for separate tissues of irradiated experimental animals (the liver, bone marrow, blood serum) is described. The curves were obtained for total irradiation in the range of absorbed doses 25 to 900 rad. (auth)

21732 STUDY OF SODIUM AND POTASSIUM DISTRIBUTION IN SPLEEN, LUNGS, AND BRAIN OF IRRADIATED ANIMALS UNDER THE EFFECT OF GALASCORBIN. Sokolava, V. I.; Zaitseva, S. D. (Medical Inst., Kiev). Ukr. Biokhim. Zh.; 45: No. 3, 347-351(1973). (In Ukrainian).

The total single irradiation at a dose of 900 R evokes phase changes in the electrolytic equilibrium; the content of potassium

decreases (in the lungs on the second, fifth, and tenth day; in the spleen on the second and fifth day, and in the brain on the tenth day) and the content of sodium increases (in the lungs on the second, fifth, and tenth day, in the spleen and brain after only five days, i.e., at the height of radiation sickness). The value of the ratio K_v/K_e (v—intracellular, e—extracellular) decreases, expecially in the spleen on the fifth day after irradiation and that of Na_e/Na_v increases. Introduction of galascorbin prevents an increase in the content of extracellular sodium and potassium in the investigated tissues of the irradiated animals. (auth)

21733 EFFECT OF X-RAY IRRADIATION ON DNA SYNTHESIS AND CELL POPULATION KINETICS IN REGENERATING RAT LIVER. II. Cell Irradiation in S and G_2 Periods. Polishchuk, A. M. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Tsitologiya; 15: No. 6, 712-721(Jun 1973). (In Russian).

Wistar male rats (150 to 160 g body weight) were subjected to irradiation at a dose of 150 R 22 hrs after partial hepatectomy (the peak time of DNA synthesis) and then slaughtered 1, 2, 3, 4, 6, 8, 11, 14, 16, 22, 26, 32, and 38 hrs after irradiation. Temporal parameters of the mitotic cycle and of H^3-thymidine incorporation into individual nuclei were determined radioautographically. Besides, the Feulgen-DNA content in labeled nuclei were determined microspectrophotometrically 1 hr after irradiation. Irradiation resulted in a drop of the labeling rate in hepatocyte nuclei, an increase in the S period duration, and in a decrease of the average DNA content per labeled nucleus. The most inhibition of DNA synthesis was noted in the nuclei irradiated at the end of S period. The delay of irradiated cells in S period results in G_2 period prolongation by 1 hr compared with the control. (auth)

21734 NON-SPECIFIC FACTORS AFFECTING THE FATE OF SKIN ALLOGRAFTS UNDER CONDITIONS OF A WEAK HOST'S RESPONSE. Polackova, M.; Viklicky, V. (Inst. of Experimental Biology and Genetics, Prague). Folia Biol. (Prague); 19: No. 3, 179-186(1973).

The fate of skin allografts across weak (non-H-2) histocompatibility barriers in mice was previously shown to be occasionally affected by reparative processes associated with wound healing following transplantation. In the present study, the intensity of such reparative processes was experimentally manipulated in order to reveal their significance under various conditions. In three histocompatibility systems presented by the H-3, H-2.32, and male-specific barriers, the donors of the skin grafts were submitted to whole-body irradiation, which tends to impair or to retard the reparation processes, and the survival of such skin grafts was followed. Grafts from irradiated donors, both neonatal and adult, had in all three systems a more or less shortened mean survival time (MST); the frequency distribution of grafts surviving up to a certain time was, however, affected selectively, the decrease of the mean survival being merely at the expense of the long-lived subpopulation. Irradiation did not alter the onset of the rejection in the early phase of the distribution of adult grafts, while with the neonatal ones not only was the proportion of permanently surviving grafts almost eliminated, but even the onset was accelerated. The results are interpreted as reflecting induced changes in the capacity of reparative processes responsible for the content in the skin grafts of acid mucopolysaccharides and an immunoresistance-conferring function of the latter. (auth)

21735 EARLY UNTRASTRUCTURAL EFFECTS OF IONIZING RADIATION. I. Mitochondrial and Nuclear Changes. Jordan, S. W.; Dean, P. N.; Ahlquist, J. (Univ. of New Mexico, Albuquerque). Lab. Invest.; 27: No. 6, 538-549(Dec 1972).

Mice were irradiated with 8.5-MeV x rays from the Los Alamos electron prototype accelerator at whole-body dose levels of 8,700 to 2,370,000 rads in exposures lasting 26 sec to 8.5 min. Experimental animals were retrieved within 60 sec and tissue fixation was begun within 2 min after completion of exposure. After less than 200,000 rads, ultrastructural alterations were equivocal and difficult to distinguish from fixation artifacts. However, mice sustaining whole-body x-ray doses of more than 600,000 rads showed mitochondrial swelling with partial dissolution of mitochondrial cristae and homogeneous intramatrical densities in cells of the liver, kidney, spleen, thymus, skeletal muscle, and cerebellum. Flocculent homogeneous densities were present in nuclei of animals receiving more than 600,000 rads whole-body dose. The mitochondrial changes were those associated with necrosis and have been described in a variety of experimental systems, although the radiation-induced changes tend to occur much more rapidly. (auth)

21736 HEMATOPOIETIC CFU IN MICE INFECTED BY THE POLYCYTHEMIA-INDUCING FRIEND VIRUS. II. Survival of Lethally Irradiated Mice Grafted with Spleen or Bone Marrow Cells from Infected Donors. Wendling, F.; Jullien, P.; Tambourin, P. (Univ., Orsay, France). Radiat. Res.; 55: No. 1, 177-188(Jul 1973).

The colony-forming unit (CFU) compartment in Friend virus-infected mice (FVP) is composed of hematopoietic CFU, which differentiate along a multipotential pattern and are able to allow the survival of isogenic x-irradiated recipients. However, the CFU present in the spleen of leukemic mice are about 8-fold less efficient than CFU from normal spleen to protect irradiated mice against acute hematopoietic death. The efficiency of bone marrow CFU is only slightly altered. The reasons for these changes are discussed. (auth)

21737 POST-IRRADIATION ENZYME ACTIVITIES OF RAT SMALL INTESTINE: EFFECTS OF DOSE FRACTIONATION. Becciolini, A.; Castagnoli, P.; Arganini, L.; De Giuli, G. (Univ., Florence). Radiat. Res.; 55: No. 2, 291-303(Aug 1973).

Fractionated irradiation of the rat's abdomen with 1200 R, given in two equal exposures, produces changes in the enzyme activities of the epithelial brush border (lactase, invertase, maltase, and leucineaminopeptidase (LAP)) of the small intestinal villi. In animals sacrificed at different times after the second irradiation three phases of enzyme activities could be discerned: an initial phase where the activities increase above those in controls; an intermediate phase where the activities are reduced; and the final phase of return to normal of enzyme activity. The fall and subsequent recovery occurs earlier for maltase and invertase than for lactase and LAP. When the time interval between doses is short (6 to 24 hours), alterations of enzyme activities are analogous to, or more extensive than, those found after a single irradiation. When the interval is longer (48 or 72 hours), the initial phase of increased activity is absent. If the time interval is greatly increased (five days) the effect of fractionated doses is similar to that produced by a single 650 R dose. (auth)

21738 EFFECT OF WHOLE-BODY X IRRADIATION OF GUINEA PIGS ON THE LIVER RIBONUCLEASE AND RIBONUCLEASE-INHIBITOR SYSTEM. Ferencz, A.; Hidvegi, E. J.; Szabo, L. D.; Varteresz, V. (Frederic Jolit-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). Radiat. Res.; 55: No. 2, 304-317(Aug 1973).

Experiments were carried out to reveal the contribution of ribonuclease (RNase) activity, the enrichment of the size and amount of polysomes, to the enhancement of protein synthesis occurring in the liver after x-irradiation. The time dependence of RNase activity was studied between 2 and 30 hr after whole-body x-irradiation of guinea pigs with 3000 R. As found, RNase activity dropped to its minimum in deoxycholate (DOC)-treated liver microsomes at 15 hr. Accordingly, fewer polysomes degraded than in unirradiated controls, as shown by the size distribution of polysomes in the pattern obtained by sucrose density gradient centrifugation. The dose dependence experiments were performed at 15 hr after x-irradiation. In microsomes not treated with DOC the alkaline free RNase did not change appreciably up to 3000 R and the total alkaline RNase activity decreased slightly between 500 and 1500 R. In microsomes treated with DOC the free RNase activity decreased appreciably and the total RNase activity slightly as a function of the dose up to 1500 R. The amount of RNase-inhibitor (RI)-bound alkaline RNase in microsomes not treated with DOC decreased slightly; in DOC-treated microsomes it rose three-to four-fold up to 800 R. The RI-content in the supernatant of unirradiated control liver microsomes was ten times higher than the total RNase activity. Also at 15 hr the RI-content rose slightly with the increasing dose. The microsomal acidic RNase activity did not show any appreciable change 15 hr after 3000 R irradiation. A discussion is presented of the role the decrease of RNase activity plays in the enrichment in size and amount of liver polysomes and of RNA in vivo in addition to the earlier confirmed RNA synthesis. (auth)

21739 ULTRASTRUCTURAL ALTERATIONS IN X-IRRADIATED EPIDERMIS. I. Basal and Spinous Layer. de Rey, B. M.; Cabrini, R. L. (Comision Nacional de Energia Atomica, Buenos Aires). J. Invest. Dermatol.; 60: No. 3, 137-149(1973).

Ultrastructural techniques were used to study alterations of rat-tail epidermis 24 and 72 hours after x-irradiation with 2, 4, 8, and 16 Krads. Twenty-four hours after irradiation the tissue showed changes in mitochondrial membranes. Intracellular and extracellular edema and nuclear inclusions also were observed. Seventy-two hours after irradiation cellular structure appeared even more affected. Most cells showed perinuclear lipid vacuoles, nuclear fragmentation, and severe mitochondrial changes. An attempt was made to relate these ultrastructural alterations with those induced by other sources of irradiation and other forms of injury. (auth)

21740 INFLUENCE OF AGE ON THE RESPONSE OF RAT STEM SPERMATOGONIA TO γ-RADIATION. Erickson, B. H.; Martin, P. G. (UT-AEC Agricultural Research Lab., Oak Ridge, TN). Biol. Reprod.; 8: No. 5, 607-612(Jun 1973).

Testes of Sprague–Dawley rats aged either 2 or 12 months

were administered 285 rads of ^{60}Co γ radiation at 45 rads/min. Irradiated animals along with controls (10 per group) were killed at postirradiation intervals varying from 5 to 120 days. Irradiation effects were assayed through testicular weights and counts of type-A spermatogonia in 50 cross sections of seminiferous tubules at stages 5 to 8 of the spermatogenic cycle. No significant difference in number of type-A spermatogonia was observed in testes of nonirradiated rats between the ages of 2 and 16 months. Irradiation reduced spermatogonial numbers to 21 to 25% of control in both age groups, but the postirradiation interval at which it occurred was different—day 5, 2 months; day 10, 12 months. By 24 days after irradiation, spermatogonial numbers had increased to 55% of control in 2-month testes, but 12-month testes were only at 40% of control. The magnitude of the difference between young and old did not change at later postirradiation stages. At 80 days after irradiation, spermatogonial numbers peaked at 90% of control in 2-month testes and 74% of control in 12-month testes. Percents of control at 120 days postirradiation were 84 and 70% for 2- and 12-month testes, respectively. These results lead to the conclusion that irradiation produces a permanent decrement in the stem spermatogonial population with the magnitude of the decrement being age dependent. (auth)

21741 CARDIAC MURAL THROMBI CAUSED BY RADIATION. Fajardo, L. F.; Brown, J. M. (Stanford Univ., CA). Radiat. Res.; 55: No. 2, 387-389(Aug 1973).

A brief literature review (9 references) is presented of studies on radioinduced lesions in the myocardium and pericardium of man, rabbits, mice, and rats. Myocardial and pericardial fibrosis with death caused by heart failure were observed in man and rabbits. In mice and rats x radiation did not cause cardiac fibrosis or death; however, ventricular mural thrombi were observed in mice. A discussion is given of species difference in radiosensitivity and tissue content of plasminogen activator. (HLW)

21742 EARLY MORPHOLOGICAL CHANGES IN THE CORTICAL AND MEDULLARY THYMOCYTES OF THE RAT AFTER WHOLE-BODY IRRADIATION. II. Quantitative Investigation. Aoyama, T. (Nagasaki Univ., Japan); Okajima, S.; Kondo, T. Radiat. Res.; 55: No. 2, 379-386(Aug 1973).

The increased irregularity of rat thymocyte nuclei observed by electron microscopy after whole-body x-irradiation with 1000 R was assessed quantitatively by the use of the I value, the ratio of the perimeter to the area of the nucleus. The mean I values for both cortical and medullary thymocytes registered an increase 1 hr after irradiation. The value for medullary thymocytes decreased at 3 hr, while it remained unchanged for cortical thymocytes. Furthermore, a decrease in number of normal cortical and medullary thymocytes as a function of time after irradiation with 1000 R was observed by electron microscopy. Analysis of the relationship between the increased nuclear irregularity and pyknosis confirmed quantitatively the previous findings that this increase in irregularity is the process preceding pyknosis. (auth)

21743 EFFECTS OF IRRADIATION SCHEDULES ON A MURINE EPENDYMOMA. Pageau, R. (Univ., Sherbrooke, Quebec). Radiat. Res.; 55: No. 2, 369-378(Aug 1973).

A murine ependymoma was given four daily fractions of 500 rads of x rays and single doses of 2300 and 3000 rads. The effects of the three irradiation schedules on the growth kinetics were compared to the changes occurring to the DNA-synthesizing tumor cells. The rates of tumor regression and recurrence were independent of the schedule used. But the 4 × 500 rads schedule was almost as effective in reducing the number of DNA-synthesizing cells as a single dose of 3000 rads. However, the time interval required before tumors given fractionated irradiation resumed growth was shorter than that needed after a single dose of 2300 rads. These results are discussed. (auth)

21744 HISTOAUTORADIOGRAPHIC OBSERVATIONS ON EARLY NORMAL AND ABNORMAL HEART DEVELOPMENT IN RAT EMBRYOS. Miyabara, S.; Okamoto, N.; Ikeda, T.; Satow, Y. (Hiroshima Univ.). Hiroshima J. Med. Sci.; 21: No. 1, 41-47(Mar 1972).

In order to clarify the mechanism of bending and rotation of the normally developing heart, the changes of DNA synthesis in the myocardial cells of both right and left ventricles were examined by autoradiography. Nonirradiated pregnant rats were administered intraperitoneally with a single dose of 0.8 mCi of ^{3}H-thymidine during the period from 10 to 15 days of gestation, and the embryos were removed 3 hrs after injection of ^{3}H-thymidine. For the production of heart anomalies, pregnant rats at 8 days of gestation were exposed to 130 rad of fast neutron irradiation. The developmental anomalies of embryonic hearts were examined by stereomicroscopy, and after serial sectioning histoautoradiographic observations were made. The labeling index of the myocardium in non-irradiated group showed a tendency of gradual decrease during 10 to 15 days of gestation, and was higher in the left ventricle than in the right ventricle through the experimental periods. In the irradiated group, no distinct difference of the labeling index due to the difference of heart looping was present. In any case, the labeling index of the ventricle identified morphologically as the left ventricle was higher than that of the right ventricle. It was suggested that the myocardial cells of the left ventricle may be elevated in proliferative activity as compared with those of the right ventricle since the labeling index of the left ventricle was higher than that of the right ventricle during the period observed. It still remains unclear whether the difference of the labeling index in both groups directly induced heart anomalies or not. (auth)

21745 DYNAMICS OF DEVELOPMENT OF LATE PATHOMORPHOLOGIC CHANGES IN THE ENDOCRINE GLANDS (HYPOPHYSIS, THYROID, ADRENALS) AFTER X IRRADIATION OF NEWBORN MICE WITH SUBLETHAL DOSES. Chomiczewski, K. (Military Medical Academy, Lodz, Poland). Folia Biol. (Krakow); 21: No. 2, 153-168(1973).

The dynamics of the pathomorphologic changes in the hypophyses, thyroid glands, and adrenals in newborn mice irradiated with 300 R of x rays was studied. Experiments were carried out with 196 mice of the inbred A strain of both sexes, in which changes were evaluated at the ages of 4, 18, 35, 45, 100, 150, and 250 days. In the hypophyses of all the irradiated mice of both sexes, the percentage of eosinophilic cells in the anterior lobe was diminished after 18 days. The remaining eosinophilic cells and basophilic cells showed weak stainability and vacuolization of cytoplasm. At the age of 250 days, the amount of neurosecretion in the posterior lobe of the hypophyses was markedly diminished in irradiated males. In 35-day-old mice the thyroids of irradiated mice of both sexes exhibited morphologic signs of hypothyroidism, which subsequently increased in intensity. In the adrenals of irradiated mice, especially females, the so-called X zone atrophied slowly in the period of sexual maturation, and later the cortex also atrophied but without showing signs of regeneration, while the RNA content in the zona fasciculata decreased; the number of cells devoid of lipids increased. By means of quantitative methods, the morphologic changes in the hypothalamo-pituitary system were found to be correlated with changes in the thyroids and adrenals. Compared with the data in the literature, the observations indicate high radiosensitivity of the endocrine glands in newborn mice. Irradiation with sublethal doses of x rays at this age caused severe, irreversible, lesions in the endocrine system and impaired regenerative processes. (auth)

21746 INTERFERON PRODUCTION AND INFECTION CAUSED BY VESICULAR STOMATITIS VIRUS IN RADIATION CHIMERAS. Mentkevich, L. M.; Orlova, T. G.; Shcheglovitova, O. N.; Solovyov, V. D. (Inst. of Epidemiology and Microbiology, Moscow). Acta Virol. (Prague) Engl. Ed.; 17: 159-162(Mar 1973).

Intracerebral inoculation of vesicular stomatitis virus (VSV) into CBA mice as well as syngeneic (CBA–CBA) and xenogeneic (Wistar rats–CBA mice) chimeras was accompanied by their death, viremia, and intensive virus reproduction in the brains, approximately similar in all the three groups of animals. In the serum and the brains of infected mice, interferon of the mouse type only was detectable; the concentrations were the highest in control mice and lower in syngeneic chimeras. In xenogeneic chimeras interferon was found either in insignificant amounts or not at all. The nucleus-containing bone marrow cells derived from VSV-infected mice produced interferon in vitro only in response to additional inoculation of Newcastle disease virus (NDV). Cells derived from xenogeneic chimeras produced, in addition to mouse interferon, also interferon of the donor (rat) type. (auth)

21747 COMPARATIVE STUDIES ON THE RADIOPROTECTIVE ACTION OF CFP_9 AND ATP. Gheorghe, N.; Stefan, M. (Inst. of Normal and Pathological Physiology, Bucharest). Rev. Roum. Physiol.; 9: No. 5, 433-438(1972).

A study was carried out on the radioprotective effect of the Romanian product CFP_9, a pyridine derivative of ATP, and a CFP/ATP mixture, administered by the intraperitoneal route 30 min before or after irradiation, in single doses of 500, 350, and 250 mg/175 mg per kg body weight respectively. The radioprotective efficiency was estimated by the survival curve and alterations in ATP-ase and pyrophosphatase activity in the liver. The results showed a good radioprotective capacity of the CFP_9 product. (auth)

21748 EFFECT OF BLOCK OF THE HYPOPHYSIS-ADRENAL SYSTEM ON COMPOSITION OF ENDOGENOUS COLONIES OF THE HEMOPOIETIC TISSUE IN THE SPLEEN OF IRRADIATED MICE. Sushkevich, G. N.; Soboleva, E. L.; Zhukova, N. A.; Tsygankov, A. P. (Research Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med.; 75: No. 6, 87-89(Jun 1973). (In Russian).

CBA mice of both sexes weighing from 25 to 30 g were used. Block of the hypophysis-adrenal system was induced by intraperito-

neal injection of dexamethasone at a dose of 250 μg per 100 g in a 0.3 ml of 0.85% NaCl solution. Three hours after administration of the preparation, the animals were irradiated with ^{60}Co gamma rays (800 R, rate–40 R/sec). Composition of endogenous colonies of the hemopoietic tissue in the spleen of irradiated mice was studied on the 10th day after the action of ionizing radiation. In the spleen of mice irradiated under conditions of block of the hypophysis-adrenal system, the number of hemopoietic colonies proved to be three and a half times greater than in the spleen of control irradiated animals. This difference was chiefly caused by a greater absolute number of erythroid, undifferentiated, and megakariocytic colonies. (auth)

21749 CHANGES IN THE NUMBER OF CELLS WITH CHROMOSOMAL ABERRATIONS IN THE BONE MARROW OF IRRADIATED MICE TREATED BY COMBINED USE OF COCARBOXYLASE AND TRYPTOPHANE. Kosarenkov, V. A.; Ostroumova, L. M.; Strashnenko, S. I. Byull. Eksp. Biol. Med.; 75: No. 6, 105-107(Jun 1973). (In Russian).

Investigations were carried out on male CC57BR mice subjected to total gamma irradiation at a dose of 500 R (dose rate, 357 R/min). Cocarboxylase and tryptophane were injected intraperitoneally in doses of 4 and 8 mg per 100 g of weight. Control mice were given no preparations. The number of cells with chromosomal aberrations in the bone marrow was determined 24 hrs after the irradiation. The number of chromosomal aberrations cells in the treated group of animals proved to be reduced in comparison with control. (auth)

21750 DEVELOPMENT OF TRANSPLANTED GONADS IN AXOLOTL LIMBS. Effects of Irradiation and Amputation of the Host Limb. Lazard, L. (CNRS, Nogent-sur-Marne, France). Compt. Rend., Ser. D; 276: No. 10, 1601-1604(5 Mar 1973). (In French).

Irradiation of the limb does not have any effect on testicles grafted onto males, but leads to the preferential transient survival of immature germinal elements of testicles grafted onto females; under the same conditions the development of the ovary is considerably delayed independent of the way it is received by the male host. Amputation of the limb of a female host slightly decreases the rate of development of the gonads and leads to the destruction of the testicle or the regeneration of the ovary. (FR)

21751 DOSE AND TIME DEPENDENCE OF RADIATION-INDUCED CHROMOSOME ABERRATIONS IN RAT EMBRYOS. 2. Irradiation in the Prenatal Period. Eicke, J.; Hug, O. (Univ., Munich). Biophys. J.; 9: No. 3, 237-242(1973). (In German).

Thirty pregnant Wistar-rats were exposed to 200 R x rays on the 17th day after conception. The animals were sacrificed 0 to 96 hr after irradiation. Nine not exposed animals served for controls. For chromosome analysis, cell cultures were made from mixed samples of fetal tissue as well as from the isolated liver. Also tissue cells of the newborn animals at day of birth were investigated. Immediately after exposure the number of cells with chromosome aberrations in the fetal tissue and the liver amounted to 83.3% and 79%, respectively. In the first 12 hr after exposure, the values decreased rapidly and approached control values within 24 hr. In a similar way the mean number of breaks per cell decreased in the post-irradiation period. (auth)

21752 LIFE SPAN AND LATE EFFECTS OF IONIZING IRRADIATION. Pauly, H. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Acta Gerontol.; No. 1, 21-27(1972). (In German).

Mammals subjected to a sublethal dose of ionizing radiation, or mammals that received a number of small doses over a longer period developed, often after a long time interval free of symptoms, leukemias and tumors. In some groups of the human population, the same late effects were observed. The ICRP derived maximum permissible doses and dose rates for different kinds of occupational exposures and for different groups of the population. These data form the basis of their recommendations. (auth)

21753 INFLUENCE OF WHOLE-BODY IRRADIATION ON THE OXIDATIVE PHOSPHORYLATION IN ISOLATED LIVER MITOCHONDRIA. Will, V. Homberg, Ger.; Univ., Saarlandes (1972). 64p. (In German).

Thesis.

The effect of whole-body irradiation in the range of 500 to 1,000 R on the oxidative phosphorylation in liver mitochondria of rats was investigated. The animals were sacrificed at intervals of 1 hr up to 10 days following irradiation; the oxygen consumption was measured by polarography, whereas the ATP was determined enzymatically. Irradiation with 500 up to 750 R did not affect the oxidative phosphorylation, no matter what kind of substrate (either succinate, β-hydroxybutyrate, or α-ketoglutarate) was used. By contrast, the effect of whole-body irradiation with 1,000 R was found to be dependent on the substrate. No reaction was observed with succinate but in the case of β-hydroxybutyrate, a slightly stronger variation of results was found in the beginning. Only the results obtained with α-ketoglutarate showed a clear effect of the 1,000 R whole-body irradiation, corresponding to a lethal dose $LD_{100/4d}$, as a diminution of the P/O quotient from 3.45 (normal) to 2.75 was found. This strongly indicates that the liver mitochondria are practically insensitive to radiation under the conditions applied in the present investigations. (GE)

21754 LYMPHOGRAPHIC INVESTIGATION OF THE INFLUX RATE OF THE CONTRAST MEDIUM IN THE PRE-IRRADIATED LYMPHATIC SYSTEM OF RATS. Roesler, P. Heidelberg; Heidelberg Univ. (1972). 32p. (In German).

Thesis.

Three groups of rats received an irradiation of the popliteal lymph nodes with x rays at 2-day intervals. The surface doses amounted to a total of 6,000 R (6 × 1,000 R) and 3,000 R (3 × 1,000 R) respectively. One group, which received no treatment, served for control. After 16, 32, and 62 days a unilateral lymphography was made. The moment at which the contrast medium reached the lumbal lymph nodes was used as a measure of the flow rate. In the 16 d- and 64 d-group, an acceleration was found that did not depend on the administered radiation dose. In the 32 d-group a delay was stated. No significant difference was found between the irradiated group and the control group. As a possible explanation of the observed acceleration of contrast medium influx, a damage of filter function of the irradiated lymph nodes is supposed that is confirmed by the experimental and clinical observations of numerous authors. (GE)

21755 EFFECT OF WHOLE-BODY IRRADIATION WITH X RAYS ON THE FORMATION OF IMMUNITY IN TETANUS TOXOID-IMMUNIZED MICE. 1. Primary Immunity to Tetanus Toxin. Galazka, A.; Albrycht, H.; Gajewski, A. K.; Grzymaia, W. J. (Panstwowy Zaklad Higieny, Warsaw). Med. Dosw. Mikrobiol.; 24: 235-245(1972). (In Polish).

The relation between various doses of adsorbed tetanus toxoid and the extent of immunity to the toxin in mice irradiated with various doses of x rays, applied at different time intervals before and after immunization was investigated. The degree of immunity was determined by the score method after Ipsen. Doses of 12.5 to 50 R decreased insignificantly the development of immunity, doses of 100 to 200 R restrained significantly the immune response, and the dose of 400 R totally inhibited the development of immunity even after large antigen doses. Irradiation with 200 R 7 days before or after immunization had no essential effect on the degree of primary immunity; however, development of immunity was significantly repressed when time intervals between irradiation and immunization were shorter. With low toxoid doses (0.2 to 0.8 BU) the immune response of irradiated mice was delayed and peaked on the 28th day; with high antigen doses differences in the response between irradiated and control mice were less distinct. (auth)

21756 VASCULAR ALTERATIONS OBSERVED IN THE MASSETER OF RABBIT IRRADIATED BY ^{60}Co γ RAYS. Amano, O. Shigaku; 60: No. 2, 139-148(Jun 1972). (In Japanese).

Six groups of rabbits were given 1000 R of ^{60}Co gamma radiation daily to the masseter muscle for total doses of 1000, 3000, 5000, 7000, 9000, and 12,000 R, respectively, at a dose rate of 19.9 R/min. Changes to the vascular material of the masseter, observed by microangiograms, included expansion and fishtailing of the capillary tubes after a dose of 1000 R, the fishtailing being most intense after 9000 R. Expansion of the arteries was seen with 3000 R, and expansion of the veins after 7000 R. Constriction, shrinking, and localized swelling took place in the capillaries at 9000 R or more, and the number of capillaries decreased. Histological observations indicated blood congestion, agglutination of blood corpuscles, thrombosis, and propagation of endodermal cells at doses above 7000 R. Changes to muscular fiber appeared at doses above 7000 R, with the myofibrils exhibiting wavelike undulations, and muscle withering. (TTT)

21757 RADIATION INDUCED HEMATOLOGICAL CHANGES IN ANIMALS. Saenger, I. Giessen, Ger.; Univ., Giessen (1972). 108p. (In German).

Thesis.

By means of a review of the available literature, a complete survey of the radioinduced hematological changes in animals is given. A short introduction into this subject is followed by a systematic survey of the test results from the years 1963 to 1971; the effects of the radiation on the corpuscles of the blood, on the coagulation and the elements of the plasma are discussed. Due to the variety of the results, these can only be summarized. Some subjects, however, are dealt with in greater detail. The test results are also examined with regard to the information to be gained from the individual changes for the diagnosis of radiation damage. It is obvious that for this diagnosis some radio-induced changes can be used in any case. Their usefulness, however, is limited by the fact that they are either methodically too complicated, or that

they are only to be used under experimental conditions. Finally, those radioinduced alterations are referred to that are most useful for the recognition of the seriousness of radiation-damage and for this reason should be tested more thoroughly in the future. (GE)

21758 CHANGES IN THE CIRCADIAN RHYTHM OF CALCIUM LEVEL IN THE BLOOD SERUM OF MICE EXPOSED TO UV AND X RADIATIONS. Zatorska, B. (Jagellonian Univ., Krakow). Acta Biol. Cracov., Ser. Zool.; 15: No. 2, 183-191(1972).

The circadian rhythm of calcium level in the blood serum of mice was considerably altered by uv and x rays. Exposure to uv resulted in the increase of Ca^{++} in the mouse serum with the maximum occurring at 24^{00}. The lowest concentration of calcium was recorded at 12^{00}. The difference between the extremum values amounted to 3.5 mg %. Exposure to x rays led to a considerable decrease of calcium level in serum as demonstrated by the determination at 24^{00}. Quantitative determinations of calcium were carried out by a micromethod of Biering (after Homolka 1958). (auth)

21759 MODELING OF THE RADIATION-INDUCED MITOTIC BLOCK. Yakovlev, A. Yu. (North-Western Polytechnical Inst., Leningrad). Tsitologiya; 15: No. 5, 616-619(May 1973). (In Russian).

Some approaches to the theoretical description of the mitotic block induced by short-term irradiation are considered. A theoretical curve constructed on the basis of the mathematical model is compared with experimental results obtained for the mouse duodenum epithelium. (auth)

21760 INFLUENCE OF TOTAL-BODY X-RAY IRRADIATION ON ENERGETIC METABOLISM IN BONE MARROW CELLS OF RABBITS. Filanovskaya, L. I.; Filippova, V. N. (Inst. of Hematology and Blood Transfusion, Leningrad). Tsitologiya; 15: No. 5, 585-591(May 1973). (In Russian).

Changes in respiration, glycolysis, and ATP level studied in bone marrow cells obtained from the rabbits within 30 min to 24 hrs after the whole-body x irradiation with 1000 R. Changes in the rate of glycolytic degradation of glucose, glucose-6-phosphate, fructose-1,6-diphosphate, and 3-phosphoglyceric acid were studied in acetone powder extracts of bone marrow cells. Anaerobic ATP synthesis in the bone marrow cells decreased 30 min after the irradiation procedure; no changes were observed in respiration or glycolysis. Respiration of myelokaryocytes 24 hrs after x-ray exposure was suppressed by 58%, whereas glycolysis and ATP levels fell by 38 and 58%, respectively. However, the respiration glycolysis interaction in bone marrow cells from non-irradiated rabbits remained unaffected. Glycolytic degradiation of glucose, glucose phosphates, and of fructose phosphates, treated with acetone powder extracts of the bone marrow cells of the x-irradiated rabbits, was slowed down by 63, 28, and 38%, respectively, thus indicating some radiation alterations at the rate limiting stages of glycolysis. (auth)

21761 CHROMOSOMAL ABERRATIONS IN THE COURSE OF RADIATIONAL AND CHEMICAL CARCINOGENESIS. Kim, V. Kh. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Tsitologiya; 15: No. 5, 578-584(May 1973). (In Russian).

Irradiated mice displayed a reduced number of induced chromosomal mutations up to the 5th month following irradiation. However by the 6th month, these increased in number, reaching by the end of one year the level of chromosome mutations in the control. The application of the chemical carcinogen (o-aminoazotoluene — OAAT) only resulted in a steady accumulation of the chromosomal aberrations in hepatocytes. The combined effect of the two above agents resulted in an immediate increase of the frequence of chromosomal mutations followed by its decrease with consequent increase after a 4 month period. In all the groups where the animals got o-aminoazotoluene, the tumors appeared on the background of a high frequence of chromosomal mutations, whereas animals treated with irradiation only displayed hepatomas in later periods when the level of chromosomal mutations was as low as in the control. This may suggest that tumor production does not necessarily involve chromosome mutations. At the combined action of the two carcinogenes, the tumors developed earlier compared to the time of appearance of these with either separate treatment. (auth)

21762 INCREASED PRECURSOR INCORPORATION INTO THE DNA OF RAT LIVER MITOCHONDRIA IRRADIATED IN VITRO. Shima, A.; Baugnet-Mahieu, L.; Goutier, R. (CEN, Mol, Belgium). Biophys. J.; 9: No. 3, 243-252(1973).

The kinetics of incorporation of labeled precursors into the DNA of isolated rat liver mitochondria was studied after irradiation in vitro. Incorporation of ^{3}H-TTP was slightly inhibited during the initial period, followed by an increase of about 25% of the specific activity. Incorporations of ^{3}H-TdR and ^{3}H-BUdR were also stimulated by irradiation of mitochondria, although the amount of incorporated precursor was lower than that of ^{3}H-TTP. This radio-induced incorporation of precursors was abolished by the addition of ethidium bromide or EDTA. Degradation of mt-DNA, indicated by the decrease of specific radioactivity, was observed after irradiation of pre-labeled mitochondria; in presence of EDTA the degradation was not detected. These results were discussed from the viewpoint of the repair synthesis of mitochondrial DNA. (auth)

21763 RADIATION DOSE RECEIVED BY PLAICE (PLEURONECTES PLATESSA) FROM THE WASTE DISCHARGED INTO THE NORTHEAST IRISH SEA FROM THE FUEL REPROCESSING PLANT AT WINDSCALE. Woodhead, D. S. (Ministry of Agriculture, Fisheries, and Food, Lowestoft, Eng.). Health Phys.; 25: No. 2, 115-121(Aug 1973).

A large proportion of the radioactive waste discharged into the north-east Irish Sea from the nuclear fuel reprocessing plant at Windscale is reconcentrated on to the seabed silt and sediment in the vicinity of the outfall. This results in an extensive environment in which benthic and demersal organisms receive a radiation dose rate significantly greater than the natural background. Calculations based on seabed radioactivity measurements made during routine environmental monitoring surveys indicated that the dose rate to the plaice (Pleuronectes platessa), a commercially important species in the area, could range up to 5 mrad hr^{-1} from β and γ radiation. In situ measurements of the dose rate regime experienced by the plaice were made with lithium fluoride dosimeters combined with the "Petersen disc" tag normally used for fish population surveys. The results show substantial agreement with the calculated dose rates and the data were used to derive an estimate of the mean dose rate to the plaice gonad. It is concluded that the increased radiation exposure experienced by the plaice will not have any discernible effect at either the individual or population level. (auth)

21764 EFFECTS OF LOW-LEVEL IRRADIATIONS ON SOME ENZYMES OF THE MALE ACCESSORY REPRODUCTIVE GLANDS OF GUINEA PIGS. Chinoy, N. J.; Shah, V. C.; Sheth, K. M. (Gujarat Univ., Ahmedabad, India). Strahlentherapie; 145: No. 5, 612-616(1973).

A biochemical study on some enzymes of the accessory glands of guinea pigs were carried out in normal, irradiated, and recovering animals. Low-level irradiation resulted in no permanent impairment of glandular function, and most of the enzymes investigated were either activated or restored to control values. The DLP phosphatases were the most radiosensitive, whereas SDH was usually activated in all accessory sex glands investigated. The results are discussed in the light of physiological functions, seminal plasma, and the changes induced by radiations. (GE)

21765 BENEFIT AND HARM FROM EXPOSURE OF VERTEBRATE SPERM TO LOW DOSES OF IONIZING RADIATION. Newcombe, H. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys.; 25: No. 2, 105-107(Aug 1973).

Exposures of trout sperm to 25 and 50 rad of ionizing radiation are shown to have both harmful and beneficial effects. Although more of the embryos from the irradiated sperm are malformed, embryo production and embryo survival are both enhanced by the treatment. With higher doses to the sperm, however, the effects are consistently harmful. Although induced genetic changes are presumed to be involved in the production of the observed differences in embryo mortality, the dose-response curve is unique in that it is not only non-linear but actually changes direction at its low-dose end. The results have a bearing on the estimation of genetic risks to man. A need for caution is indicated in attempts to equate small radiation exposures of human germ cells with apparent increases in fetal and infant mortality. (auth)

21766 MICROCIRCULATION OF IRRADIATED SPONTANEOUS OSTEOSARCOMA IN DOGS. A Preliminary Report With Special Reference to the Effect of Fractionation. Paatsama, S.; Rissanen, P.; Rokkanen, P.; Sittnikow, K. (Coll. of Veterinary Medicine, Helsinki). Acta Radiol., Suppl.; No. 319, 153-158(1972).

From 2nd international conference of veterinary radiologists; Stockholm, Sweden (1970).

Of 13 dogs with spontaneous osteosarcoma 6 were irradiated with a Caesatron. Three dogs received 1000, 2000, and 3000 rad respectively in a weekly dose of 1000 rad. Three dogs received the corresponding weekly dose in daily fractions. Microangiographic examination showed that the large doses caused obstructions of small blood vessels and obstructions and constrictions of the larger vessel. One thousand rad given in 5 daily fractions caused no noticeable vascular changes. Two thousand and 3000 rad given as daily fractions caused slight changes in the minor blood vessels while the larger vessels remained open. (auth)

21767 SERIAL TRANSPLANTATION OF BONE-MARROW CELLS IN IRRADIATED ISOGENEIC MICE. Pozzi, L.; Andreozzi, U.; Silini, G. (CNEN, Rome). Curr. Top. Radiat. Res. Quart.; 8: No. 3, 259-302(Mar 1973).

Serial passage of haemopoietic cells into heavily irradiated animals has often been employed in an attempt to exhaust their division potential and thus test the extent of their renewal capacity. On repeated transplantation the bone-marrow stem cells, like those of the spleen, show, in general terms, a reduction of their division potential: this is manifested by a progressive decline of the percentage of clonogenic cells, by a parallel reduction of their capacity to restore haemopoiesis of lethally irradiated hosts and by a decreased rate of repopulation of the bone marrow of the transplanted animals. A number of variables concerning this type of experiment were examined, including the splenic or marrow origin of the transplanted cells; the total number of cells and of clonogenic cells transplanted; the time interval between transplants; the capacity of the donor cells to repopulate different haemopoietic sites. The decline in the renewal capacity of the bone-marrow cells is a complex phenomenon that may be brought about by changes in the individual cells or by changes at the level of the transplanted cell population. The data available in the literature and the present series of experiments are inadequate to draw definite conclusions about the nature of this phenomenon. In addition, they do not prove that the division capacity of the haemopoietic progenitor cells is indeed indefinite, although they do not provide firm evidence to the contrary. The emergence of three lines of reticulum cell sarcoma has been followed in the experiments described: the high frequency of this type of tumour in the strain of animals used suggests that the technique of serial transplantation did not act causally in inducing the malignant transformation of the transplanted cells, but was instrumental in favoring the selection of fast-growing cell lines transformed by other, possibly viral, agents. (auth)

21768 CHANGES IN THE TRANSPLANTABILITY OF MASTOCYTOMA CELLS AFTER THE IRRADIATION OF THE HOST ANIMAL WITH X RAYS. Nishimoto, Y.; Nakamura, W.; Kojima, E. Compt. Rend. Soc. Biol.; 166: No. 8, 1189-1193(1972). (In French).

The effect of irradiation of the host animal on the replication rate of ascitic mastocytoma cells transplanted at different times after the irradiation was studied. A whole-body irradiation of 500 R caused a considerable increase in the replication rate, the maximum occurring after a duration of 5 minutes and then of 3 to 5 days following the irradiation. The leukocytic system does not appear to play an important role in the phenomenon. (FR)

Invertebrates

Refer also to abstract 21836.

21769 (IAEA-R-540-F) PATHOGENESIS AND IMMUNITY OF FASCIOLA GIGANTICA INFECTION IN CATTLE. Part of a Coordinated Programme of Research on Use of Isotopes and Radiation in Studies of Etiology, Effects and Control of Parasitic Disease in Domestic Animals. Final Report, 1 September 1967–30 June 1971. Bitakaramire, P. K. (International Atomic Energy Agency, Vienna (Austria)). Aug 1971. 11p. INIS.

In an attempt to immunize young cattle against Fasciola gigantica, 6 months old bull calves were given perorally two doses of 1000 metacercariae each with an interval of 42 days. The metacercariae were gamma irradiated with 3000 rads and non-irradiated, respectively. After another interval of 100 days a challenge dose of 1000 infective metacercariae was given, followed by autopsy 2 to 3 months later. These studies were complemented by determination of albumin turnover using ^{125}I albumin and of iron turnover by use of ^{59}Fe. When, at autopsy, the livers were checked for worms retained from the challenging application, it was found that double vaccination with irradiated metacercariae reduced the worm burden to less than 1% of the original number. Calves infected with the same dose of non-irradiated metacercariae and challenged likewise exhibited a worm recovery of approximately 28%. The experiments showed that a significant immunizing effect was achieved by application of irradiated metacercariae. No adverse effects on liver parenchyma after such treatment were observed. Albumin turnover rate was markedly increased during the prepatent period of the infection, whereas plasma iron turnover was only slightly affected. These effects are attributed to feeding activities of the immature parasites in the bile ducts, rather than to mechanical damage in the liver tissue. (INIS)

21770 RADIATION AFTER-EFFECT IN VARIOUS TYPES OF DROSOPHILA MUTATIONS. Petrova, L. G.; Tikhomirova, M. M. (Leningrad State Univ.). Genetika; 9: No. 5, 56-65 (May 1973). (In Russian).

The non-linear character of the dependence of dominant lethal mutations on the dose in Drosophila oocytes and the damaging and protective effects of radiation were shown using the method of a successive effect of x-irradiation at different doses and high temperature. (auth)

21771 NICHE-VARIATION HYPOTHESIS: AN EXPERIMENTAL STUDY WITH DROSOPHILA POPULATIONS. Shugart, H. H. Jr.; Blaylock, B. G. (Oak Ridge National Lab., TN). Amer. Natur.; 107: No. 956, 575-579(1973).

Data from previously published studies on the effect of radio-induced mutations on competing Drosophila populations were used to test the niche-variation model in an experimental context. Increased genetic variability was found to increase the niche width of highly inbred populations of D. simulans. With higher degrees of variability, the nature of the genetic material appeared to become more important than variability alone. These results tend to validate the niche-variation model. (auth)

21772 RADIOPROTECTIVE EFFECT OF SIX CHEMICALS AGAINST X-RAY-INDUCED GENETIC DAMAGE IN D. MELANOGASTER. Jacob, M.; Ray-Chaudhuri, S. P. (Banaras Hindu Univ., India). Mutat. Res.; 18: No. 3, 279-288(Jun 1973).

In Drosophila melanogaster, six chemicals were tested for radioprotective effect against x-ray-induced genetic damage such as sex-linked recessive lethals and autosomal translocations using Oster's ring-X chromosome stock. A 2-day brood pattern was followed to score the damage induced at different spermatogenic stages separately. In all cases the chemicals were injected before x irradiation. A 10-mM solution of reduced glutathione (GSH) provided statistically significant protection against sex-linked recessive lethals in all broods. In translocation tests this chemical reduced the frequency in all broods but the result is not statistically significant. Cysteamine (MEA) did not show any protective effect but the frequency of lethals was slightly reduced in the first and fourth broods. 2-Aminoethyl isothiuronium Br · HBr (AET) showed a statistically significant protective effect when the data of the replicate experiments were pooled. Negative results were obtained for 5-hydroxytryptamine (5-HT) in sex-linked lethal tests. Aminoethyl phosphorothioate (AEPT) reduced the frequencies of both sex-linked lethals and autosomal translocations in all broods consistently but the results are not statistically significant. In tests for both lethals and translocations the reduction was largest in the stages with highest radiosensitivity. N(3-Aminopropyl)aminoethyl phosphorothioate (3AP-AEPT) gave no protection. (auth)

21773 MODIFICATION OF RADIATION-INDUCED GENETIC DAMAGE IN DROSOPHILA MELANOGASTER MALE GERM CELLS WITH NUCLEIC ACID PRECURSORS. II. Effects on Post-Meiotic Cells. Rajaraman, R.; Kamra, O. P. (Dalhousie Univ., Halifax, N. S.). Mutat. Res.; 18: No. 3, 289-299(Jun 1973).

Following the observation that the nucleoside pre-treatment reduced the radiation-induced dominant lethality in the post-meiotic germ cells, similar experiments were conducted using the same treatment conditions to study the influence of the nucleoside(s) pre-treatment on the radiation-induced (1.2 kR) incidence of sex-linked recessive lethals and translocation events in the post-meiotic male germ cells of 1-day-old D. melanogaster. The nucleoside pre-treatment reduced the translocation frequency (not statistically significant) and the lethal mutation frequency (statistically significant) in the post-meiotic cells (pre-injection DNA synthesis cells) especially in the mature sperms sampled in brood a (br a). The radioprotective effect of the nucleosides on the mature sperms was confirmed using 7-day-old virgin male males and different radiation doses (2.4 kR and 3.6 kR). The frequency of lethal mutation was lowest when irradiation was preceded by the injection of an equimolar solution of thymidine (TdR), deoxyadenosine (AdR), deoxycytidine (CdR), and deoxyguanosine (GdR). However, when the nucleosides were injected after irradiation (within 10 to 30 min) there was no change in the yield of radioinduced lethals. The possible mechanisms for the radioprotective action of the nucleosides in the post-meiotic germ cells such as protection by a radiochemical action of nucleosides competing for short-lived radicals that might otherwise cause damage to DNA and biochemical-physiological mechanisms such as metabolic events increasing the radioresistance of the cells, providing excess energy for repair or favoring and partaking in the DNA repair synthesis were discussed. Further studies were felt necessary to elucidate this phenomenon. (auth)

21774 LETHALITY: DEPENDENCE ON DEVELOPMENTAL RATE IN X IRRADIATED PUPAE OF TRIBOLIUM. Soliman, M. H. (Univ. of Alberta, Edmonton). Experientia; 29: No. 5, 550-551(15 May 1973).

Pupae of eight laboratory populations of Tribolium castaneum were x-irradiated and dead adults were recorded in two-day intervals after five days of emergence. A correlation was found between the age at pupation and adult survival time. Tables are presented to show fitness measurements in terms of lethality and interpopulation correlations between fitness and response to x radiation. (HLW)

21775 COLONY FORMATION OF THE WESTERN HARVESTER ANT IN A CHRONIC GAMMA RADIATION FIELD. Isom, B. G. (Tennessee Valley Authority, Muscle Shoals); Yokley, P. Jr. Amer. Midland Natur.; 89: No. 2, 446-448(Apr 1973).

A colony of Western harvester ants, Pogonomyrmex occidentalis, became established in a chronically exposed gamma radiation field located on the native short-grass plains of Colorado. The exposure level at the nest site was 18 R/hr. At the end of the colony's first and second seasons the nest mound diam were 25 and 36 cm, respectively, and did not appear to differ from those in non-irradiated areas. There were no apparent habitat modifications to suggest any avoidance response to the radiation. (CH)

21776 EFFECTS OF ACUTE GAMMA IRRADIATION ON THE BRINE SHRIMP, ARTEMIA. III. Male F_1 Reproductive Performance Following Paternal Irradiation of Mature Sperm. Squire, R. D. (Long Island Univ., Brooklyn). Biol. Bull.; 144: No. 1, 192-199(Feb 1973).

Male brine shrimp (Artemia) were hatched from commercially obtained Californian cysts and irradiated as adults with acute doses of 0, 1, 2, 3.5, 5, or 10 kR γ rays. Each male was individually pair mated to a white eye female. The F_1 were raised to maturity and scored for survival to adulthood, sex ratio, and F_1 male reproductive performance. There was a significant decrease in F_1 survival to adulthood after paternal doses of 3.5, 5, and 10 kR, but not at lower doses. A significant increase in male sex ratio was observed after 5 and 10 kR, and these males were almost completely sterile. A paternal dose of 3.5 kR resulted in a 44 per cent decrease in the number of fertile males and some fertile males were semi-sterile. No apparent effect was observed after 1 or 2 kR. These data support the proposed holokinetic nature of the Artemia chromosome. They also demonstrate that the observable effects of radiation may be much more extreme in the F_1 animals than in the irradiated generation itself. This observation has important implications when assaying the effects of radiation on natural populations. (auth)

21777 HAWAIIAN FRUIT FLIES IN PAPAYA, BELL PEPPER, AND EGGPLANT: QUARANTINE TREATMENT WITH GAMMA IRRADIATION. Seo, S. T.; Kobayashi, R. M.; Chambers, D. L.; Dollar, A. M.; Hanaoka, M. (Honolulu, Hawaii). J. Econ. Entomol.; 66: No. 4, 937-939(Aug 1973).

Minimum doses of γ radiation of 20.9, 21.4, 24.6, 25.2, and 29.1 krad in papaya, bell pepper, or eggplant for thicknesses of 1.47, 1.73–1.87, 2.18, 2.81, and 3.14 g/cm^2, respectively, prevented emergence of the adult oriental fruit fly, Dacus dorsalis Hendel; melon fly, D. cucurbitae Coquillett; and Mediterranean fruit fly, Ceratitis capitala (Wiedemann). The irradiated population developed to 3rd-stage larvae, but the number of larvae was reduced significantly by refrigeration at ca. 7.2°C. Two-day-old or 12-day-old adult oriental fruit flies that were irradiated with minimum doses were sterile for longer than one month. (auth)

21778 CONFUSED FLOUR BEETLES: X-RAY AND/OR MALATHION MODIFICATION OF POPULATION FITNESS. Kinkade, M. L.; Erdman, H. E. (Texas Woman's Univ., Denton). J. Econ. Entomol.; 66: No. 4, 967-972(Aug 1973).

Data were developed concerning the effects of malathion and x-ray given singly or in combination on the reproductive fitness in populations of Tribolium confusum Jacquelin duVal. Virgin mature beetles sexed as pupae were x-rayed with 0, 1, 2, or 4 kr. From these, 10 pairs were placed on flour media containing various concentrations of malathion (0 to 100 ppM). Culture conditions were 29 ± 2°C and 30 to 35% relative humidity. Parental mortality and productivity (number of F_1 adults) were measured. The minimum lethal dose of malathion for adult T. confusum was between 10 and 20 ppM. Concentrations less than 10 ppM decreased productivity but did not affect adult mortality during eight-week experimental period. Larval development was retarded by malathion concentrations of 2.5 ppM or greater, with onset of pupation delayed several days. Progressively fewer adults eclosed at 10 and 20 ppM. X-ray doses progressively decreased the reproductive capacity of T. confusum. Exposure to four kR reduced productivity to less than three percent that of control population. Productivity was reduced less by one and 5 ppM malathion than 10 ppM, the latter of which caused extermination of F_1 populations by the fourth week. Parental beetles were not killed by 0 to 10 ppM malathion or 0 to 4 kR x-ray. The effects from the radiation and malathion combination were more detrimental to the reproductive capacity than were the effects of either stress given singly. An interaction between the malathion and the x-ray effects was obvious, with additive effects noted at all treatments except four kR. The stress from malathion and/or x-ray caused progressive reductions in numbers of almost all F_1 populations as dose levels of insecticide and ionizing radiation were increased singly and in combination. (auth)

21779 PATTERN FORMATION IN IMAGINAL DISCS OF DROSOPHILA MELANOGASTER AFTER IRRADIATION OF EMBRYOS AND YOUNG LARVAE. Postlethwait, J. H.; Schneiderman, H. A. (Univ. of California, Irvine). Develop. Biol.; 32: No. 2, 345-360(1973).

Embryos and first instar larvae of Drosophila melanogaster were x-irradiated in order to study pattern formation in discs damaged at early stages. After treatment, appendages were found in which some pattern elements were duplicated and others were absent. In some strains legs were preferentially duplicated, and in others, antennae were preferentially duplicated. Duplicated appendages were mirror images and resulted most frequently when animals were irradiated during late embryonic or early larval stages. Appendages varied from those that showed complete duplication of only the distal parts (claws or aristae), to those that showed duplication of almost the entire appendage. Examination of the cuticular patterns in duplicated mesothoracic legs showed that in legs with complete duplication solely in distal regions, only extreme lateral leg parts were duplicated, and medial leg parts were absent. In legs with duplication extending into proximal regions, much of the lateral side was duplicated, and only extreme medial parts were missing. The situation for partially duplicated antennae was similar. Prothoracic legs were found fused in some x-rayed flies. The cuticular patterns were almost perfect mirror images, although the amount of fusion varied widely between different individuals. Apparently the pattern forming processes in the right and left first leg discs are coordinated in x-rayed animals. The results were consistent with a model embracing a gradient of developmental capacity in the early disc similar to that postulated to exist in the late third instar leg disc. This model is also consistent with results of various surgical experiments reported in the literature. Several predictions of the model are explained including the possible mode of action of a specific class of mutants that may affect pattern formation by altering a morphogenetic gradient. (auth)

21780 EFFECT OF IRRADIATION ON MATING COMPETITIVENESS OF THE MALE TICK ARGAS PERSICUS (OKEN). Sternberg, S.; Peleg, B. A.; Galun, R. (Israel Inst. for Biological Research, Ness-Ziona). J. Med. Entomol.; 10: No. 2, 137-142 (25 Apr 1973).

Both male and female Argas persicus mated more than 10 times. Males γ irradiated at doses that induce 99% dominant lethals (12 kR) were fully competitive for the first 2 to 3 weeks after exposure, then became aspermic. Decreasing the irradiation dose to 3 kR increased fertility to about 30%, but aspermia occurred about the same time as in higher doses. (auth)

21781 GAMMA-IRRADIATED PINK BOLLWORMS: ATTRACTIVENESS, MATING, AND LONGEVITY OF FEMALES. Flint, H. M.; Staten, R. T.; Bariola, L. A.; Palmer, D. L. (Dept. of Agriculture, Phoenix, AZ). Environ. Entomol.; 2: No. 1, 97-100 (Feb 1973).

Mass-reared female moths of the Phoenix PPD strain of Pectinophora gossypiella (Saunders), irradiated with doses of up to 40 krad were assessed for attractiveness in field traps, mating ability, and longevity. The data indicated that females irradiated with 10 to 25 krad were fully as attractive to native males as unirradiated females in the field. Hexalure (25 mg/trap) was more attractive to native males than 1 to 5 virgin females in the field. Although females irradiated with a sterilizing dose of 30 krad mated as frequently as unirradiated females, a significant reduction (30%) in their ability to receive sperm in their spermathecae occurred in single matings to unirradiated males. The longevity of males and females irradiated with 10 to 25 krad was not significantly different from unirradiated moths. The average LT_{50} and LT_{90} values for females held at 30°C were 20 and 24 days, respectively. (auth)

21782 EFFECTS OF IONIZING RADIATION ON CONSUMPTION, DIGESTION, AND UTILIZATION OF FOOD BY THE DESERT LOCUST, SCHISTOCERCA GREGARIA FORSKAL. Rao, P. J.; Mehrotra, K. N. (Indian Agricultural Research Inst., New Delhi). Indian J. Exp. Biol.; 10: No. 5, 350-356(Sep 1972).

Effects of three sublethal doses of ^{60}Co gamma radiation, viz. 1000, 2500, and 5000 R on consumption, digestion, and utilization of cabbage by 5 to 8 days old adults of S. gregaria were studied for a period of 10 days. The food intake, fecal production, and weight gain of irradiated insects were significantly lower as compared to non-irradiated ones and were dose dependent. There was almost continuous weight gain by both irradiated and non-irradiated insects up to the 8th day, after which the irradiated insects lost weight in contrast to gain in weight by non-irradiated ones. Although there was no significant difference in average digestibility of dry matter as well as carbohydrates between irradiated and non-irradiated insects, nitrogen digestibility was seriously affected by irradiation. During the experimental period, the food

and carbohydrate balance of irradiated insects decreased with time and was significantly lower as compared to non-irradiated ones. The nitrogen balance of irradiated insects, consistent with digestibility, decreased tremendously especially during the last three days of the experimental period. The consumption index and growth rate of irradiated insects were significantly lower as compared to non-irradiated ones and were dose dependent. Except for the first 6 days, during which the gross efficiency of 5000 R-irradiated insects was significantly higher as compared to non-irradiated ones owing to greater maintenance requirements of the latter, no significant difference in either gross or net efficiency of food utilization to body matter was observed between irradiated and non-irradiated insects. The probable involvement of various factors in the effects observed in irradiated insect was discussed. (auth)

21783 RADIATION AFTER-EFFECTS IN VARIOUS TYPES OF DROSOPHILA MUTATIONS. II. Non-disjunction and X-Chromosomal Loss. Tikhomirova, M. M.; Petrova, L. G. (Leningrad State Univ.). Genetika; 9: No. 6, 81-92(Jun 1973). (In Russian).

The threshold of action and after-effect of x rays on non-disjunction of X-chromosomes was established and the parabolic character of the dose-effect curve was shown when studying the effect of radiation on the females of two Drosophila lines (D-18 and D-32). The frequency dependence curve of exceptional males on x-ray dose was parabolic for females of line D-18 and was a straight line for females of the line D-32. The x-ray after-effect was inversely proportional to the irradiation dose. The results obtained are interpreted with respect of the aberration hypothesis of the mechanism of generating exceptional males and females under irradiation. (auth)

21784 RADIATION AFTER-EFFECTS IN VARIOUS TYPES OF DROSOPHILA MUTATIONS. III. Recessive Sex-Linked Lethal Mutations. Petrova, L. G. (Leningrad State Univ.). Genetika; 9: No. 6, 93-99(Jun 1973). (In Russian).

By the method of successive action of x rays at doses of 0.1, 0.5, 1.5, and 3.0 kR and of high temperature (37°C), recessive sex-linked lethal mutations in females of two lines (D-18 and D-32) of Drosophila were studied. The non-linear dose dependence is demonstrated in the treated female generation. After-irradiation, temperature treatment led to the increase in the frequency of mutations in comparison with x irradiation in the line D-18, but was not effective in the line D-32. The x-ray after-effect (at the dose of 1.5 kR) in the line D-18 was 47.1%. (auth)

21785 SOME EFFECTS OF SUB-LETHAL X-IRRADIATION ON REPRODUCTION AND DEVELOPMENT IN TWO STRAINS OF LARVAL TAENIA CRASSICEPS. Beavers, P. E.; Esch, G. W.; Kuhn, R. E. (Wake Forest Univ., Winston-Salem, NC). Int. J. Parasitol.; 1: 235-239(Dec 1971).

The generation times were determined for two larval strains of Taenia crassiceps. The aberrant strain (ORF) had a generation time (generation time = time from inoculation to initial bud production) of 23 days while for the normal (KBS) strain it was 32 days. Exposure to 10,000 R of x irradiation of ORF larvae resulted in a significant stimulation of reproductive potential. Reproductive potential of first and second generation progeny of the irradiated ORF larvae paralleled that of nonirradiated ORF cysticerci, indicating an ephemeral effect of radiation. Doses of 10,000 R had no apparent reproductive or morphologic effect on KBS larvae. (auth)

21786 MODIFICATIONS PRODUCED BY X IRRADIATION ON THE WEIGHT AND WATER CONTENT OF CERATITIS CAPITATA. Lemaitre, C. (Univ., Lyon). Compt. Rend., Ser. D; 276: No. 16, 2419-2422(16 Apr 1973). (In French).

The modifications produced by exposure to x rays on the thermogenesis of Ceratitis capitata were studied for the different stages occurring within the puparium. The effect of irradiation on weight was investigated. The significance of the weight changes occurring depended on the dose given and the time when the irradiation was effected. Studies were also made of the modifications occurring in the water contents. (FR)

21787 ASYMMETRICAL RESPONSES TO DIRECTIONAL SELECTION FOR RADIATION RESISTANCE AND SENSITIVITY IN DROSOPHILA. Westerman, J. M.; Parsons, P. A. (La Trobe Univ., Bundoora, Australia). Experientia; 29: No. 6, 722-724 (15 Jun 1973).

Female D. melanogaster from radio-resistant and radiosensitive populations were exposed to 110,000 rads of ^{60}Co γ radiation. Selection of resistant and sensitive lines was terminated after 5 generations. Selection was very effective for resistance but not for sensitivity. The asymmetrical selection effect depended on dominant inheritance of resistance. It was possible to show through sib-selection that the genetic variation for radioresistance in the base populations could be selected without any contact with the selective agent. (HLW)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 21631, 21632, 21663, 21680, 21810, 21812, 21813, 21841, 23288, and 23592–23594.

21788 (BNWL-tr-86) SWEDISH PILOT STUDY OF LUNG CANCER AMONG MINERS. Sundell, L.; Axelson, O.; Rehn, M.; Josefson, H. Translated from Laekartidningen; 68: No. 49, 5687-5693(1971). 8p. Dep. NTIS $3.00.

Radon and radon daughters have been observed not only in uranium mines but in higher or lower concentrations in other mines. An increased mortality rate from lung cancer has long been known among workers in mines containing uranium, and has also been observed abroad in nonuranium-working mines. Excess mortality from lung cancers has been observed among miners in zinc mines in Sweden where in 1969 to 1970 the radon daughter content was about 30 to 100 pCi/litre. An exposure time of a quarter of a century or longer is normally observed before the development of lung cancer. About a 13-fold increase in the lung cancer mortality rate seems to have occurred among miners in the active ages, whilst the remainder of the male population in the district exhibits normal cancer mortality. Thus the conclusion is drawn that cancerogens occur in the mine and are probably comprised of radon and radon daughters, but other etiological factors must also be considered, e.g. cancerogenous metals in mine dust and/or other cancerogens. Experience shows that proper ventilation would have a good prophylactic result. (auth)

21789 (RT/PROT-(73)4) ^{226}Ra DOSES DUE TO BOTTLE FEEDING. Frittelli, L.; Mastinu, G. G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 Feb 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

The widespread use of powdered milk mixed with mineral water for the bottle feeding of infants in Italy makes it possible to estimate the radiation dose due to the ingestion of ^{226}Ra during the first year of life from data obtained by analyzing a limited number of samples. Data are presented on estimates of the α dose and dose rate to bones and soft tissues. (CH)

21790 DETERMINATION OF DOSE LOADING IN LIVER EXAMINATIONS WITH ^{198}Au ISOTOPE. Erdelyi, K.; Fuezy, M. Magy. Radiol.; 25: No. 2, 102-106(Apr 1973). (In Hungarian).

In liver examinations with ^{198}Au, the dose loading was determined according to the method worked out by Snyder et coll. Among the data necessary for the calculation of the dose loading the biological evolution (enrichment, removal) of the radioactive isotope was examined; the blood clearance curve above the temporal artery, the site of accumulation (by scintigraphy), and the alteration of the activity of the total body (with total-body counter) were measured. The absorbed dose in the liver, in the total body, and in the blood was determined. (auth)

21791 URANIUM MINING AND CIGARETTE SMOKING EFFECTS ON MAN. Archer, V. E. (National Inst. of Occupational Safety and Health, Salt Lake City, Utah); Wagoner, J. K.; Hyg, S. D.; Lundin, F. E. Jr. J. Occup. Med., 15: No. 3, 204-211(Mar 1973).

A substantial excess of lung cancer, reduced pulmonary function, and emphysema among uranium miners has been reported. The excess was attributed primarily to irradiation of the tracheobronchial epithelium by alpha particles emitted during the radioactive decay of radon and its daughter products. These radioactive elements collect in the air and on the dust in mine atmospheres and are inhaled by miners. Control of this hazard has been largely by ventilation. In the United States lung cancer has appeared, predominantly among cigarette-smoking uranium miners whose lung cancer has a shorter induction-latent period than does lung cancer among non-cigarette smoking miners. However, the incidence of lung cancer increases with increasing radiation exposure among groups with similar smoking habits. Cigarette smoking appears to have little or no influence on histologic type of lung cancer among uranium miners, but does reduce the induction-latent period of those cancers. The precise role of cigarette smoking in the lung cancers of uranium miners is not clear. (CH)

21792 CANCER MORTALITY AMONG URANIUM MILL WORKERS. Archer, V. E.; Wagoner, J. K.; Lundin, F. E. Jr. (Dept. of Health, Education, and Welfare, Salt Lake City). J. Occup. Med.; 15: No. 1, 11-14(Jan 1973).

During the period 1950 through 1967, a total of 104 deaths were observed among the 715 uranium mill workers, which was nearly the same as that expected based on rates for the white male population of the area. Although the overall mortality was the same as expected, the excess deaths due to malignant diseases of the lymphatic and hematopoietic tissue other than leukemia does appear to be meaningful. (CH)

21793 THOROTRASTOSIS OF LIVER. van Kaick, G.; Wegener, K. (Deutsches Krebsforschungszentrum, Heidelberg). (1972). vp. (In German).

From 27th meeting of the German Society for Digestive and Metabolic Illnesses; Frankfurt am Main, Germany (5 Oct 1972).

Twenty eight years after injection of 20 ml of Thorotrast, the liver is subjected to a radiation dose of 600 rods. No characteristic pathomorphological signs of radiation damage were seen. Results of studies in 700 living patients and investigation of the fate and causes of death of 900 dead Thorotrast patients are given. Forty histologically evident liver tumors were found. (GE)

21794 PENTOSE CYCLE IN ERYTHROCYTES OF URANIUM MINERS. Vich, Z.; Novosad, F.; Brychtova, V.; Safandova, M. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 13-17(1970). (In Czech).

An increased activity of the pentose cycle, a decreased activity of glucose-6-phosphate-dehydrogenase and an increased activity of glutathion-reductase were observed in erythrocytes of uranium miners. The relationship was studied between the activity of the pentose cycle and the survival half-life of erythrocytes and the value of erythrocyte cholesterol. The results are believed to confirm an altered function of uranium miners erythrocytes. (Nucl. Sci. Abstr. Czech.)

21795 DOSE TO THE FETUS FROM RADIONUCLIDES IN THE BLADDER. Cloutier, R. J. (Oak Ridge Associated Universities, TN); Smith, S. A.; Watson, E. E.; Snyder, W. S.; Warner, G. G. Health Phys.; 25: No. 2, 147-161(Aug 1973).

A geometric model that takes into account the changes in size, shape, and position of the uterus during pregnancy was designed for calculating the radiation dose to the uterus and the fetus from a radionuclide in the mother's bladder. The bladder is assumed to fill at a constant rate to 300 ml before voiding. The average dose in rads per photon emitted from a source in the bladder during one bladder filling was calculated for monoenergetic photons of 0.02, 0.03, 0.05, 0.1, 0.2, 0.5, 1.0, 1.5, 2.0, and 4.0 MeV. Since the dose to specific organs of the fetus could not be calculated, the fetal space was divided into 12 compartments. The dose was calculated for each compartment, for the average of the entire fetal space, and for the uterus. The average dose per photon to each compartment decreases as the fetus increases in size. The highest dose rate to the uterine wall occurs at the point where it touches the bladder. Because the uterus enlarges, the point on the uterus receiving the highest dose rate changes during pregnancy. (auth)

21796 CHANGES IN THE DISTRIBUTION OF LIPOID SUBSTANCES IN THE BLOOD OF URANIUM MINERS. Adamek, M.; Roth, K.; Stepankova, M. (Inst. of National Health in Uranium Industry, Pribram, Czech.). Sb. Ved. Odbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram; 5: 19-22 (1970). (In Czech).

Changes were observed in the distribution of lipoid substances in the blood of uranium miners. Relationships were found between the duration of exposure and the concentration of radon in the inhaled air. From the obtained results and from data published elsewhere it was concluded that the phenomena represented a compensation of changes in the erythrocytes membranes induced by ionizing radiation, i.e. an adaptation. (Nucl. Sci. Abstr. Czech.)

21797 CHRONIC MYELOID LEUKEMIA, 27 YEARS AFTER THOROTRAST INCORPORATION. van Kaick, G.; Drings, P.; Lohoelter, H. (Deutsches Krebsforschungszentrum, Heidelberg). Strahlentherapie; 145: No. 5, 582-587(1973). (In German).

A 58-year-old patient developed a chronic myeloid leukemia 27 yrs after an angiography with Thorotrast. The cases reported so far concerning affections of the bone marrow in Thorotrast carriers are discussed, as well as the results of the epidemiological Thorotrast studies. According to these epidemiological studies, made in several countries, the incidence of hematological diseases in Thorotrast carriers is higher than in the average population. In persons whose thorotrastosis is an indirect consequence of a war disablement, the connection between the deposition of thorium dioxide in the bone marrow and the myelopathy should, with regard to the equalization of undue hardship, be admitted. (GE)

Animals

21798 RELATIVE BIOLOGICAL EFFICIENCY OF TRITIUM OXIDE IN REMOTE PERIODS. Moskalev, Yu. I.; Zhuravlev, V. F.; Istomina, A. G. Gig. Sanit.; No. 6, 51-55(Jun 1973). (In Russian).

In two tests performed on 1008 albino rats, relative biological efficiency of tritium oxide was studied in comparison with the action of equivalent doses of ^{137}Cs γ rays. Judging by the life-length and the incidence of tumors of mammary glands, the biological efficiency of tritium oxide is at an average of 1.8 times more intensive than that of ^{137}Cs γ irradiation. (auth)

21799 FORMATION OF TUMORS IN DOGS AT LONG TIMES AFTER INTRODUCTION OF ^{210}Po AND OXATHIOL. Lebedev, B. I.; Lebedeva, G. A.; Parfenov, Yu. D. Vop. Onkol.; 19: No. 6, 97-102(1973). (In Russian).

Twenty-five mongrel dogs, 1 to 2 years old, were given a single subcutaneous dose of ^{210}Po (2.5 uCi/kg) and numerous doses of oxathiol in the next month (total of 1250 mg/kg) to accelerate polonium elimination. The animals were sacrificed over the next 12 years whenever clinical signs of tumors appeared, and the organs were examined histologically for the presence of tumors. The results showed tumors in the adrenals and testicles appearing after 4 to 6 years, in the liver and pancreas in 6 to 8 years, and in the thyroid and kidneys in 8 to 10 years. The data indicate a very high carcinogenic effect of ^{210}Po. The radiation doses to the organs mentioned were 35, 55, 100, 10, 15, and 530 rads, respectively. (TTT)

21800 COPPER DEFICIENCY AND MOLYBDENOSIS INTOXICATION ASSOCIATED WITH GRAZING NEAR A URANIUM MINE. Dollahite, J. W.; Rowe, L. D.; Cook, L. M.; Hightower, D.; Mailey, E. M.; Kyzar, J. R. (Texas Agriculture Experiment Station, College Station). SW. Vet.; 26: No. 1, 47-50(1973).

A disease in cattle suggestive of copper deficiency and/or molybdenosis has been observed in Atascosa, Ellis, and Karnes Counties in Texas. The disease was diagnosed as molybdenosis in 1972 on a ranch in Karnes County where uranium ore had been mined and stored. Grass and soil samples collected contained high levels of molybdenum and low levels of copper. (auth)

21801 HISTOLOGICAL AND HISTOCHEMICAL STUDIES ON ^{45}Ca INDUCED OSTEOSARCOMA IN RATS. Harayama, K. (Kagoshima Univ., Japan). Nippon Seiko Giho; 46: No. 11, 1023-1039(Nov 1972). (In Japanese).

Osteosarcoma was induced by ^{45}Ca in Donryu rats and histological and histochemical investigations were performed on polysaccharide, nucleic acid, lipid, oxydase, dehydrogenase, trace element, inorganic substance, and microautoradiogram. Microscopically, the primary tumor revealed typical osteosarcoma. During the course of transplantation, a change of the histological picture was observed; that is, until the 4th generation tumorous osteoid was observed but after the 5th generation osteoid tissue was not seen and the tumor changed to fibrosarcomatous cells. In metastatic foci, histological findings were similar to that of primary tumor. DNA was more abundant in proliferating cells. In ^{45}Ca-induced osteosarcoma, glycogen was scanty, and the tumor mostly contained mucoprotein or acid mucopolysaccharide. After the 5th generation, polysaccharide was not observed. Lipid contents were low in ^{45}Ca-induced osteosarcoma. Phosphatase activity was intense in tumor cytoplasm. No differentiation of the activity was noted between the peripheral and central area of the tumor. After the 5th generation these enzymatic activities were relatively diminished. In successive transplantation enzymatic activities were diminished from the 5th generation. In metastatic foci, the activities of G-6-PDH, MDH, and IDH were quite intense, but those of LDH and SDH were low. β-glucuronidase activity increased a little at a dense part of cells and it has relation to the proliferation of cells. Phosphorylase was distributed in the cytoplasm of primary tumor until the 4th generation but this reaction disappeared after the 5th generation and in the metastatic foci. Trace elements, copper and zinc accumulated in the osteoid tissue. However, the physiopathological signification was unknown. Calcium and phosphate were also deposited in the osteoid matrix. (auth)

21802 EFFECT OF TRITIATED WATER ON THE DEVELOPMENT OF THE RAT OOCYTE AFTER MATERNAL INFUSION DURING PREGNANCY. Haas, R. J.; Schreml, W.; Fliedner, T. M.; Calvo, W. (Univ., Ulm, Ger.). Int. J. Radiat. Biol.; 23: No. 6, 603-609(Jun 1973).

The effect of continuous exposure in utero to tritiated water (HTO) was studied in the post-natal oocyte development of Wistar rats. Pregnant rats were given daily doses of 290 to 5800 μCi HTO intravenously from the ninth day of pregnancy until term. During the first 21 days of life, a dose-dependent reduction of oocyte number was observed. A dose of 1450 μCi decreased the total oocyte number to 50% of the controls. Accelerated maturation of oocytes was not demonstrable. The highest dose of 5800 μCi produced total aplasia in the ovaries. The number of oocytes is apparently one of the most sensitive parameters of β-irradiation damage. A comparison with data after continuous ^{3}H-thymidine (^{3}H-TdR) application showed a ten times higher effect of ^{3}H-TdR compared with HTO. The mechanisms for this phenomenon are discussed, and it was concluded that the final posi-

tion of the tritium compound in the cells is the most important factor in the radiobiological effect. (auth)

21803 DEVELOPMENT OF OSTEOGENIC SARCOMA BY ^{89}Sr. Observation by Means of Microautoradiography. Akasaki, T. (Kanazawa Univ., Japan). Nippon Seikei Geka Gakkai Zasshi; 46: No. 12, 1121-1137(Dec 1972). (In Japanese).

After injection of ^{89}Sr-solution in mice, ^{3}H-thymidine, ^{3}H-proline, and $H_2{}^{35}SO_4$ were administered intraperitoneally at regular intervals during the following thirty weeks. Both femurs of the mouse were prepared for microautoradiography. The microautoradiograms were examined on the osteogenic cells of endosteum, periosteum, and trabecula, and on the epiphyseal cartilage cells. Conical and cylindrical portions of femur were studied separately and compared with that of control groups. Uptake of ^{3}H-thymidine indicates DNA synthesis and ^{3}H-proline is taken up in the process of collagen synthesis of bone matrix, and ^{35}S enters chiefly into the synthesis of chondroitin sulfate in cartilage matrix. Damages of bone by ^{89}Sr β radiation recover after fifteen weeks. At the period, recovery of cell proliferation preceeds that of matrix formation. Abnormal cellular proliferations appear on the inner surface of distal diaphysis of femur at twenty five to thirty weeks after ^{89}Sr administration. They are considered to be the cells originating from the osteogenic cells of endosteum. The areas of the abnormal cell proliferation show high uptake of the ^{3}H-thymidine, ^{3}H-proline, and ^{35}S, and it was inferred that, maintaining the functional activities of their original cells, the abnormally proliferating cells go on the way to malignancy. (auth)

Plants

21804 EFFECTS OF CHRONIC INTERNAL β-RADIATION FROM PHOTOASSIMILATED $^{14}CO_2$ ON THE RETENTION AND DISTRIBUTION OF ^{14}C IN YOUNG WHITE PINE PLANTS. Ursino, D. J. (Brock Univ., St. Catharines, Ont.). Plant Physiol.; 51: 954-959(1973).

Eastern white pines (Pinus strobus L.) in their 3rd year of growth photoassimilated 35, 110, 220, or 400 microcuries of $^{14}CO_2$ on a single occasion in the spring when needle expansion was occurring. Once assimilated into organic products and translocated to various sinks, the retained ^{14}C represented an internal chronic source of ionizing radiation to the plant. About 2.5 months later, the pines were harvested, and the distribution of ^{14}C activity was determined. In addition, new needle lengths, fresh weights, and rates of processes involving CO_2 exchange were measured. All parameters measured were affected in those pines which initially assimilated 220 or 400 microcuries of $^{14}CO_2$, whereas no significant differences were observed between control plants and those initially assimilating 35 microcuries. Plants incorporating 110 microcuries were intermediate in their responses. The percentage of assimilated ^{14}C retained by the plants decreased as the initial activity of assimilated ^{14}C increased, with the losses of ^{14}C occurring through both respiration and the shedding of needles. The pines which assimilated 35 microcuries of $^{14}CO_2$ retained about 70% of the ^{14}C; those which assimilated 400 microcuries retained only about 28%. The distribution of the ^{14}C activity recovered from all the plants was essentially the same; about 65% of the total ^{14}C recovered was in the new needles and 13% in the roots. (auth)

Microorganisms

21805 EFFECTS OF THE DECAY OF INCORPORATED RADIOACTIVE PHOSPHORUS ON THE TRANSFER OF THE BACTERIOPHAGE SP82G GENOME. McAllister, W. T.; Green, D. M. (Univ. of New Hampshire, Durham). J. Virol.; 12: No. 2, 300-309(Aug 1973).

The last genetic markers to be transferred during bacteriophage SP82G infection have a higher sensitivity to the decay of incorporated radioactive phosphorus (^{32}P) than those located on the proximal end of the genome. If ^{32}P decay is permitted to take place after DNA transfer is complete (in frozen infective centers) and in the absence of DNA replication, no dependence of marker sensitivity on map position is observed. These results indicate that the decay of incorporated ^{32}P leads to damages that prevent the efficient transfer of portions of the genome distal to the lesion. At 4°C, failure to transfer some portion of the genome occurs in 49% of all lethal events. Even though damages that prevent transfer of the genome are in themselves lethal, they do not prevent rescue of genetic markers on portions of the genome that are transferred. The portion of the genome that is transferred, is transferred at the same rate as an undamaged genome. These results are interpreted to mean that double-strand breaks in the DNA are the lesions that prevent distal transfer and that single-strand breaks have little or no effect on the transfer of the bacteriophage SP82G genome. (auth)

21806 KILLING OF ^{32}P-LABELLED SINGLE-STRANDED-RNA BACTERIOPHAGE MS2. Lupker, J. H.; Glickman, B. W.; Roersch, A.; Bosch, L. (Univ., Leiden). Eur. J. Biochem.; 35: No. 2, 206-208(1973).

The killing of highly ^{32}P-labeled bacteriophage MS2 by transmutation was studied. The efficiency of killing was calculated according to the method of Hershey and was found to be 0.60 ± 0.08. This value is significantly lower than the value expected for a single-stranded bacteriophage. These results can be interpreted by assuming either that the MS2 RNA is replicated with the breaks caused by radiophosphorus decay, or that the breaks are repaired before replication. (GE)

Nuclide Kinetics and Toxicology

21807 MATHEMATICAL TREATMENT OF THE RESULTS OF RADIOMETRY OF THE WHOLE BODY. Niyazova, Zh. M.; Sereda, M. G.; Kaplan, M. A. (Scientific-Research Inst. of Medical Radiology, Erevan). Med. Radiol.; 18: No. 6, 25-28 (Jun 1973). (In Russian).

A method of analysis of the results obtained on the unit for measuring total radioactivity is suggested. It was shown that with the use of a collimated detector for measuring radioactivity in the organs it is possible to study the nature of radioactive isotopes behavior in the body as a whole, in extravascular and vascular space and in separate organs with the deduction of the blood. The method described can be used after intravenous and peroral introduction of the label. (auth)

21808 GRAPHICAL APPROXIMATION OF CURVES OF RADIOACTIVITY OF THE WHOLE BODY AND SEPARATE ORGANS. Matveenko, E. G.; Bolotnikov, M. V. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 18: No. 6, 29-35(Jun 1973). (In Russian).

For quantitative evaluation of information obtained with the help of dynamic radiometry of the whole body and separate organs a simple graphic method of approximation of radioactive curves by means of a sum of exponents is proposed. The techniques of checking the possibility of the experimental curves presentation by the sum of 2 or 3 exponents are described. A case of expansion of comparatively complex curves with the minimum value is considered. The possibilities of the proposed graphical methods are illustrated on the example of examination of the radioactivity curves of the whole body, thyroid gland, heart region, liver, and the femur after one-time introduction of ^{131}I. Radiometry of the mentioned regions was made on a unit measuring total radioactivity. Amplitudes and time constants (periods of half-retention or half-accumulation) of corresponding exponents thus detained can be considered as signs characterizing iodine metabolism and thyroid hormones. It creates a possibility of making a diagram for differential diagnosis of different diseases. (auth)

Man

Refer also to abstracts 21629 and 21858.

21809 (MLM-2047(OP)) CHESTWALL TISSUE MEASUREMENTS FOR LUNG COUNTING APPLICATIONS. Tomlinson, F. K.; Brown, R.; Anderson, H.; Robinson, B. (Mound Lab., Miamisburg, Ohio). 1973. Contract AT-33-1-Gen-53. 6p. (CONF-730907-7). Dep. NTIS $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

A whole-body counter was calibrated for the detection of ^{238}Pu in the lungs of man. Quantitative measurements depend on the detection of the 17 keV (average) x ray associated with the decay of ^{238}Pu. Because the half-value layer for 17 keV x rays in tissue is only 6 to 7 mm, the effective thickness of the tissue overlaying the lungs must be accurately determined for proper interpretation of the counting data. The tissue thickness over the lungs was determined by ultrasonic measurements over the second, third, and fourth rib. (CH)

21810 RADIOPHARMACEUTICAL TOXICOLOGY AND DOSIMETRY. Miller, J. P. (Abbott Labs., Chicago). pp 29-35 of Radioisotope in Pharmakokinetik und Klinischer Biochemie. Hoffman, G. (ed.). Stuttgart; Schattauer (1970).

From 6th annual meeting of the Society for Nuclear Medicine; Wiesbaden, Germany (26 Sep 1968).

Radio-pharmaceutical toxicology and dosimetry must take into account two kinds of factors: pharmacologic or pathologic hazard due to physiologic response, and radiation hazard. The first of these potential hazards is generally of little significance, since actual doses of radioactive pharmaceuticals are generally well

below pharmacologically effective levels and usually are below chemically detectable levels. The second potential hazard is that of radiation. Internal radiation dosimetry is discussed and estimates of delivered internal radiation dose are presented. In general the radiation delivered by the use of radioactive pharmaceuticals is within considered safe limits. The physician must weigh the potential radiation hazard against the usefulness or the value of the medical information obtained. With most modern diagnostic radiopharmaceuticals, the radiation dose is so low as to make the hazard minimal or negligible. This is not to imply that radiation can be ignored since, in spite of many years of research, still painfully ignorant of the potential biological effects of low doses of radiation. (auth)

21811 DIRECT ASSESSMENT OF RADIOACTIVE BODY BURDENS IN HUMAN. Colard, J. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp B.5.1-B.5.9 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The apparatus and methods used at the Nuclear Centre, CEN/SCK, of Mol, Belgium for the detection of body contamination of the workers by direct methods are surveyed. It is indeed necessary to be able to guarantee a continuous inspection of the personal contamination level, by routine examinations performed with a frequency depending on the nature and amounts of radionuclides that are handled, and of the work conditions. Some examinations are performed every two weeks, monthly, quarterly, twice or once a year. Otherwise emergency examinations must be performed in case of incidents detected through contamination of epiderm, clothes, air or laboratory. These examinations give identification and results about incorporated radionuclides; it will allow a modification of the working conditions in order to reduce the risks of contamination, and, possibly, will give information to the doctor for further therapeutic treatment. A direct measurement, in situ, is the more useful as it directly gives informations about the radioelement body burden without any assumption about metabolism as one must do for interpretation of excreta measurements; it is well known that this metabolism can be different from one patient to another and is disturbed by pathologic diseases, depends on the chemical form of the radioelement, and on the incorporating path. (BE)

21812 CALCULATION OF THE WHOLE-BODY RADIATION DOSE AND IN THE THYROID DURING APPLICATION OF ^{131}I. Kunkel, R.; Oberhausen, E. (Univ. des Saarlandes, Homburg, Ger.). pp 633-635 of Radioisotope in Pharmakokinetik und Klinischer Biochemie. Hoffmann, G. (ed.). Stuttgart; Schattauer (1970). (In German).

From 6th annual meeting of the Society for Nuclear Medicine; Wiesbaden, Germany (26 Sep 1968).

A procedure for the determination of extrathyroidal activity by means of whole-body counting is presented. For a group of normal persons and hyperthyroid patients the ^{131}I-activity distribution in the thyroid and the extrathyroidal ^{131}I-activity were measured. From these values the radiation dose in the thyroid and in the whole body was calculated. (GE)

21813 PROBLEMS OF PHYSICAL AND BIOLOGICAL RADIATION DOSIMETRY AFTER THERAPEUTICAL RADIONUCLIDE INCORPORATION. Pfannenstiel, P. (Univ., Freiburg i.B.). pp 503-516 of Radioisotope in Pharmakokinetik und Klinischer Biochemie. Hoffmann, G. (ed.). Stuttgart; Schattauer (1970). (In German).

From 6th annual meeting of the Society for Nuclear Medicine; Wiesbaden, Germany (26 Sep 1968).

The difficulties arising in the practical application of physical and biological methods in radiation dosimetry after the incorporation of radionuclides for therapeutical purposes are described. The results refer only to therapy using ^{131}I. It has been administered orally to a group of 32 patients suffering from diseases of the thyroid. Another 33 patients suffering from diseases of the abdominal lymph nodes, received ^{131}I endolymphatically in an oily x-ray contrast medium. In the first five weeks following the application of ^{131}I, the following investigations were carried out in all 65 cases: 1. (a) Determination of ^{131}I content and time of retention of ^{131}I in the iodine adsorbing tissues (b) calculation of adsorbed dose 2. (a) measurement of the blood-^{131}I level and (b) based on these values, assessment of the whole-body radiation dose 3. (a) determination of the cellular constituents in the peripheral blood and, subsequently, (b) attempts to correlate the changes observed with the calculated whole-body radiation doses. (GE)

21814 CONTROL MEASURES TAKEN IN THE RADIATION PROTECTION SECTOR FOLLOWING THE PART BODY CONTAMINATION BY ^{90}Sr. Chone, B.; Fehrentz, D. (Univ., Heidelberg). Therapiewoche; 23: No. 18, 1562-1565(1973). (In German)

A report is given of the partial contamination of two people by strontium-90, which occurred in the industrial region (exchange of a ^{90}Sr sample in dose ratemeter). Following a description of the case, an outline of the actual measures taken by the radiation protection sector is given and the necessity of sufficient long term examination control is shown. (GE)

21815 COMMENT ON THE BIOLOGICAL HALF-LIFE OF ^{137}Cs IN MAN. Clemente, G. F. (CNEN, Casaccia, Italy). Health Phys.; 25: No. 2, 200-201(Aug 1973).

It was recently claimed by Cryer and Baverstock (Health Phys.; 23: 394 (1972)) that the differences in biological half-life of ^{137}Cs in males and females can be accounted for by differences in body mass. This statement is in contradiction with earlier reported work. Reasons are given which indicate that the Cryer and Baverstock statement may not be soundly based. The main objection is that all variables influencing the ^{137}Cs biological half-life in man other than body mass were not kept constant, while in the previously reported work (Health Phys.; 21: 709 (1971)), contradicted by the Cryer and Baverstock work, body mass, age, dietary habits, and health status were standard. (UK)

21816 HAZARDS FROM RUPTURE OF A TRITIUM ACTIVATED LUMINOUS SOURCE. Skibin, D. (Israel Atomic Energy Commission, Beersheba). Health Phys.; 25: No. 2, 184-186(Aug 1973).

The hazards resulting from the rupture of a glass tube containing a tritium-activated luminous source have previously been reported (McNelis et al., Health Phys.; 22: 161 (1972)). In that experiment swine were used and the relevant effect of enclosing source and swine in a tent was evaluated against the effect obtained in the open. In the present study, the actual source strength used was computed, a possible explanation of the observed difference between the tritium body burdens of swine placed at different orientations but equal distances from the source is given, and the initial radioactive cloud dimensions are considered. It is shown that crushing of such a tube upwind from a person even in the open could sometimes be more dangerous than staying in or entering an enclosure in which a tube is crushed. Immediately moving away from a cloud trajectory would minimize and may even prevent exposure. (UK)

21817 EVALUATION OF INTERNAL EXPOSURE TO RADIONUCLIDES OF I, Cs, AND Co DURING MAINTENANCE OPERATIONS ON PRIMARY STEAM LEAK IN A NUCLEAR POWER STATION. Bhat, I. S.; Hegde, A. G.; Chandramouli, S.; Iyer, R. S. Health Phys.; 25: No. 2, 135-139(Aug 1973).

A case of internal exposure due to the inhalation of primary steam leaking from a boiling water reactor power station was followed up by whole-body counting and urinalysis. The thyroid burden of radioiodine and body burden of radiocesium and radiocobalt were measured from the 3rd day to the 50th day after exposure. Urinary excretions of ^{131}I and $^{134+137}Cs$ were also followed up from the third day of exposure. The dose due to this internal contamination was estimated on the basis of ICRP procedures. The effective half lives, percentage urinary excretions, and body retention and elimination relationships for these radionuclides were evaluated for this case. For all three nuclides, the body elimination was observed to be exponential with fast and slow components. In the present case the half-times were observed to be smaller than those given by ICRP, indicating a faster turnover. (auth)

21818 MEASUREMENT AND ANALYSIS OF LONG-TERM ^{22}Na RETENTION USING A WHOLE-BODY COUNTER. Yabumoto, E. (National Inst. of Radiobiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 1, 44-57(Jan 1973). (In Japanese).

Long-term sodium metabolism was studied in two adult patients with essential hypertension. Measurements of ^{22}Na retention were made by a whole-body counter with scanning geometry. The retention curves under free sodium intake showed leveling off effect at the level of 0.1%. Two hundred and fifty days after intravenous administration of ^{22}Na, the retention reached to the minimum measurable activity (MMA) with counting accuracy of 3% standard deviation, and 400 days after, the retention reached to the minimum detectable activity (MDA). Mathematical analysis of retention data was performed using 2-compartment model or its equivalent hydrodynamic model. The ^{22}Na concentration in rat organs on 95 days after administration was compared to that of ^{24}Na 24 hrs after administration. The second compartment of the model was confirmed to be a slowly exchanging sodium pool in the bone. The sodium content in this pool was estimated to be 2 to 3% of the total exchangeable sodium (including slowly exchanging fraction). The principle of measurement of total exchangeable sodium (Na_e) by the conventional method was shown to be valid within 2% error until the retention reached the 10% level. The subsequent Na_e

values showed rapid erroneous increase. Theoretical curves that are important to estimate the metabolism of stable sodium were derived from analyzed data of the present experiment with single administration of ^{22}Na. Technical problems arising from whole-body counting were also discussed. (auth)

Animals

Refer also to abstracts 21159, 21847, 21860, 23952, 23956, 23959, and 24059.

21819 (UR-3490-334) INHALATION STUDY OF A SUB-MICRON SIZE LEAD-212 AEROSOL. Bianco, A.; Gibb, F. R.; Morrow, P. E. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1973. 6p. (CONF-730907-10). Dep. NTIS $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Dogs (purebred female beagles ~10 kg) were briefly exposed to a submicron aerosol of ^{212}Pb having an effective diffusion diameter between 105 to 120 Å. The resulting lead burden was followed for up to 72 hours postexposure by external counting of the 240 keV γ ray. The concentration of ^{212}Pb in the arterial and mixed venous blood were regularly measured and no significant A−V difference could be found. The blood concentration data were used to differentiate between the ^{212}Pb level actually in the lungs and that within the thoracic blood volume. This approach was facilitated by the intravenous injection of ^{212}Pb so that in increment in ^{212}Pb concentration in the blood could be correlated with the increment in thoracic radioactivity. Seven canine studies indicated that the submicron aerosol of ^{212}Pb was cleared from the lungs with a single exponential process having a biological half-life of ~12 hours. This mean value corresponds closely to the biological half-times in human lungs reported by other investigators for ^{212}Pb and ^{210}Pb labelled aerosols of diverse physical and chemical forms, viz. 8 to 12 hours, suggesting that the clearance value can be generalized for atmospheric lead. Evidence is presented that the blood is a principal clearance pathway and that external assessment of radioactive lead in the thorax must also consider the lead content of the thoracic wall structures. (auth)

21820 USE OF RADIOMETRY FOR DETERMINING IN LIVING BODIES THE RESORPTION OF A SUBCUTANEOUS DEPOSIT OF ^{32}P. Yurasova, O. I.; Nazarenko, A. F.; Solov'eva, T. G.; Amrin, K. R. (Inst. of General and Communal Hygiene, Moscow). Gig. Sanit.; No. 5, 77-79(May 1973). (In Russian).

The resorption rate for subcutaneous ^{32}P in animals subjected to the action of solutions of surface active agents and complex metallic salts was determined. Disodium phosphate labeled with ^{32}P was added to sterile physiological solution for injecting into guinea pigs and white rats. The time required for various fractions of the Na_2HPO_4 to be resorbed by the animals was measured for two groups: a control group, and a group which were fed cholesterol. An increase in the penetration rate of the indicator was noted for the cholesterol-fed group. (KSW)

21821 ASSESSMENT OF MICRODISTRIBUTION OF α-EMISSION ISOTOPES IN THE PULMONARY TISSUE. Pavlovskaya, N. A.; Potapova, I. N.; Pavlovskii, F. A. (Inst. of Hygiene and Prophylaxis, Erevan). Med. Radiol.; 18: No. 7, 30-34(Jul 1973). (In Russian).

Quantitative assessment of microdistribution of α-emission isotopes in the tissue sections of the lungs in mice is discussed. A method of studying the section under the microscope is given; the diameter of the field of vision is substantiated (and consequently magnification). The classification of the results and their statistical treatment are considered. (auth)

21822 INCREASED URINARY EXCRETION OF A BASEMENT MEMBRANE LIKE GLYCOPROTEIN IN ACUTE URANIUM NEPHROPATHY. Griswold, W. R.; McIntosh, R. M. (Columbia Univ., New York). Experientia; 29: No. 5, 575-576(15 May 1973).

Rats were injected with uranyl nitrate and determinations were made of urine protein excretion. After five days all animals were killed and serum creatinine determinations were made. Uranium poisoning was associated with a 50% increase in excretion of major urinary glycoprotein. The uranium treated animals showed marked renal morphological alterations. No unique urinary protein fragments were recognized in the urine of uranium rats as compared to normals by immunoelectrophoresis using antisera. (HLW)

21823 STUDY OF CHEMICAL STATE OF RADIOACTIVE ISOTOPES IN THE BODY TO EXTRAPOLATE EXPERIMENTAL DATA OBTAINED ON ANIMALS TO MAN. Zapol'skaya, N. A.; Fedorova, A. V.; Voevodina, T. M. (Leningrad Scientific-Research Inst. of Radiation Hygiene). Gig. Sanit.; No. 5, 45-47 (May 1973). (In Russian).

The authors suggest to extrapolate the experimental data obtained on animals to that on man on the basis of metabolism kinetics of radionuclides and intensity of catabolism of proteins with which the radionuclides are connected. (auth)

21824 TRANSFER OF SELECTED RADIONUCLIDES FROM THE ORGANISMS OF PREGNANT AND FEEDING FEMALE RAT TO THE OFFSPRINGS. Baltrukiewicz, Z.; Derecki, J.;Pogorzelska-Lis, M. (Military Inst. of Hygiene and Epidemiology, Warsaw). Acta Physiol. Pol.; 24: No. 3, 437-444(1973).

The passage of ^{95}Zr, ^{131}I, ^{137}Cs, and ^{144}Ce from the blood of the mother through the placenta to the fetus and through milk to the organism of suckling rats was studied. Considerable differences were found in the rate of transplacental and transmammary passage of these radionuclides. Transplacental passage of ^{137}Cs was greatest while that of ^{144}Ce was smallest. (auth)

21825 INCORPORATION AND ELUTION OF RADIOCHROMIUM ^{51}Cr IN ERYTHROCYTES DAMAGED BY HEATING. Sebestik, V. (Charles Univ., Prague). Blut; 25: No. 6, 370-375 (1972). (In German).

The incorporation and elution of radiochromate (^{51}Cr) in rat erythrocytes damaged by heating in a +49.5°C warm water bath for 30 min was followed in vitro. The damaged erythrocytes were incubated with ^{51}Cr for 30 min at room temperature and the percentage of ^{51}Cr utilization in the red blood corpuscles was measured. In all experiments, a slight increase in incorporation appeared, although it was not significant. A small, nevertheless statistically significant increase of the ^{51}Cr and hemoglobin levels in the plasma was observed after a 90-min incubation of labeled and heat-injured erythrocytes in non-active plasma at physiological temperature of +37°C. (GE)

21826 METABOLIC CHARACTERISTICS OF ^{241}Am IN THE ADULT BABOON. Cohen, N.; Wrenn, M. E. (New York Univ., NY). Radiat. Res.; 55: No. 1, 129-143(Jul 1973).

The metabolism of ^{241}Am injected intravenously as the citrate was studied in four adult female baboons for periods ranging up to 6 months postinjection. In vivo retention measurements were made with γ scintillation detectors positioned over the whole body and over various specific organ sites. In addition, ^{241}Am concentrations were measured in urine, feces, blood, and biopsy samples of liver and the frontal bone of the calvarium to determine the rates and routes of deposition and excretion. By these techniques and from data obtained at sacrifices at 1 and 3 months postinjection, it was determined that the major early sites of deposition of ^{241}Am in the baboon are in bone (≃45%) and liver (≃26%). Furthermore, the elimination rate of ^{241}Am from bone was considerably slower ($T_{\frac{1}{2}}$ eff. = several years) than that from the liver ($T_{\frac{1}{2}}$ eff. from 1.5 to 4 months). The activity present in the liver appears to be almost totally excreted via the fecal route. (auth)

21827 ASSESSMENT OF THE ^{220}Rn FRACTION RETAINED IN MICE AFTER A SINGLE INJECTION OF ^{224}Ra. Malatova, I.; Dvorak, V.; Pifflova, L. (Charles Univ., Prague). Radiat. Res.; 55: No. 1, 160-168(Jul 1973).

The time course of ^{224}Ra, ^{212}Pb, and ^{212}Bi retention and ^{220}Rn exhalation was measured in two groups of mice after a single intraperitoneal administration of ^{224}Ra. The retained ^{220}Rn fraction was calculated using two approaches: (1) From measured activity of ^{220}Rn in exhaled air and from ^{224}Ra retention data. (2) From the measured ^{212}Pb or ^{212}Bi retention and using a theoretical time course of the retention of these radionuclides; it was assumed in this case that the retained ^{220}Rn fraction is constant within the duration of the experiment, i.e., during the first 3 wk after ^{224}Ra administration. The retained fractions found using the two approaches are in good agreement equaling 60 to 70% in both groups of mice; thus the fraction exhaled amounts to 30 to 40%. (auth)

21828 DECORPORATION OF MONOMERIC PLUTONIUM FROM THE DOG BY GLUCAN AND/OR DTPA. Baxter, D. W.; Rosenthal, M. W.; Lindenbaum, A. (Argonne National Lab., IL). Radiat. Res.; 55: No. 1, 144-152(Jul 1973).

Monomeric 239-plutonium was injected intravenously into beagle dogs to determine the effectiveness of DTPA (diethylenetriaminepentaacetic acid) and glucan, a polysaccharide derived from yeast cell walls, as agents for plutonium decorporation. DTPA therapy (100 mg/kg) was initiated six days after plutonium injection and continued, on a twice weekly basis, for 84 days. Glucan (15 mg/kg), given in conjunction with DTPA to a second group of dogs, was administered on days 6, 34, and 62. Control animals received sterile saline in place of both DTPA and glucan. When all animals were sacrificed on day 90, the liver burden in control dogs was the same as previously determined at day 6. DTPA therapy removed over 96% of this plutonium; removal from

spleen, lungs, kidneys, testes, muscle, and lymph nodes ranged between 50 and 90%. The total skeletal content was also reduced by 50%. Adjunct therapy with glucan did not result in significant additional removal of plutonium, probably because of the high effectiveness of DTPA given alone. Species differences in the deposition of plutonium in liver as related to the effectiveness of DTPA therapy, with possible implications for man, are discussed. (auth)

21829 DISTRIBUTION AND EXCRETION OF MOLYBDENUM-99 IN MICE. Rosoff, B. (Yeshiva Univ., New York); Spencer, H. Health Phys.; 25: No. 2, 173-175(Aug 1973).

A study is presented of the variation with time of the tissue distribution of ^{99}Mo and of the urinary and fecal excretions of this radioisotope in the laboratory mouse. Since the distribution of molybdenum in poisoned animals is similar to the trace distribution, ^{99}Mo was used as the tracer. The liver, kidney, and pancreas of mice show the highest concentrations of ^{99}Mo both at 1 and 24 hr. The concentration of ^{99}Mo in the liver remained the same at 1 and 24 hr while the ^{99}Mo concentration in most of the tissues had decreased at 24 hr. The decline in whole blood was greater than that of other tissues. The main pathway of excretion of ^{99}Mo is via the kidney, and about 36% of the dose is excreted in urine in 24 hr. (UK)

21830 METABOLISM OF SOME CHEMICAL SPECIES OF RADIO RUTHENIUM IN THE RAT. 1. Early Fate of Ingested Ruthenium. Enomoto, Y.; Watari, K.; Ichikawa, R. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 13: No. 4, 193-198(Dec 1972).

The whole-body retention of three chemical complexes of ^{106}Ru was studied in rats. Three ruthenium complexes were ruthenium chloro complex (Ru-chloro), nitrosyl ruthenium nitrato complex (RuNO-nitrato), and nitrosyl ruthenium nitro complex (RuNO-nitro). When the complexes were administered orally, RuNO-nitro complex showed the highest retention, while RuNO-nitrato and Ru-chloro complexes demonstrated a comparably low retention. The cumulative urinary excretion for three days of RuNO-nitro complex was the highest. The excretion of RuNO-nitrato was slightly but significantly higher than that of Ru-chloro complex. When the compounds were injected intravenously, the whole body retention of Ru-chloro complex was the highest, followed by RuNO-nitrato and RuNO-nitro in this order. These results suggest that RuNO-nitro complex was absorbed more readily through gastrointestinal wall to the body than RuNO-nitrato and Ru-chloro and that RuNO-nitro and -nitrato complexes in the body were metabolized and excreted faster than Ru-chloro complex. (auth)

21831 DIBUTYRYL CYCLIC AMP AND ADRENALINE INCREASE CONTRACTILE FORCE AND ^{45}Ca UPTAKE IN MAMMALIAN CARDIAC MUSCLE. Meinertz, T.; Nawrath, H.; Scholz, H. (Univ., Mainz). Naunyn-Schmiedebergs Arch. Pharmakol.; 277: No. 1, 107-112(1973).

The effects of 10^{-3} M dibutyryl cyclic AMP (DB-AMP) and 2.2×10^{-6} M adrenaline on contractile force, ^{45}Ca uptake, and total myocardial Ca concentration were investigated in electrically driven left auricles isolated from rat hearts. The experiments were performed at an extracellular Ca concentration of 0.45 mM and at low frequency of stimulation (15 beats/min). Calcium-45 exposure was 5 min. Under the conditions used, both drugs increased contractile force and enhanced ^{45}Ca uptake by about 30% (DB-AMP) and 40% (adrenaline), respectively. Thus, the results provide evidence that the effects of adrenaline on ^{45}Ca uptake in mammalian cardiac muscle can be mimicked by DB-AMP. (GE)

21832 ANALYSIS OF ISOTOPIC EXCHANGE IN ISOLATED FROG SKIN. Moshagen, D. (Univ., Munich). (1973). vp. (In German).

From 41st meeting of the German Physiology Society; Duesseldorf, Germany (27 Mar 1973).

The distribution of the so-called transport sodium in frog skin was studied. The isolated abdominal frog skin was charged with ^{24}Na from the side of the epithelium by using the method of crowbarring in an Ussing chamber, with the charging solution passing through both ends of the chamber. Perfusion was discontinued after 20 min, the skin was washed and put into a second chamber where it was perfused at both sides with Ringer solution for 60 min. The eluate of corium and epithelium was collected separately at intervals of 30 sec and measured. Three different components could be observed in the curves describing the phases of the washing-out process over a period of 60 min. It was found that the addition of strophantin results in a change in the absolute and percentage values of the three phases, but not in their half-lives, as it causes a marked decrease of the amount of Na washed out during the first phase, and an increase of this amount during the third phase. It is thought that this change in the compartments prevents a drop in the overall amount of transport sodium washed out during the three phases. (GE)

Plants

Refer also to abstracts 21108, 21598, and 23924.

21833 RADIODECONTAMINATION OF FOODSTUFFS. Porzucek, H. Przem. Spozyw.; 26: 433-436(1972). (In Polish).

The external decontamination (washing, scrubbing, peeling) of foodstuffs is relatively easy. In internal decontamination particularly important is the technological treatment. Milk is best decontaminated by the ion exchange method. Good results are also obtained in the decontamination of fruits, vegetables, and cereals. (auth)

New Tracer Techniques

Refer also to abstracts 20681, 21690, 21790, 23920, 23943, 23944, 23962, and 24070.

21834 (CNEA-344) LABELING OF GRAM-NEGATIVE BACTERIAL STRAINS WITH RADIOIODINE-131. Ugalde, R. A.; Viglocco, A. M.; Colma, A.; Gutierrez, B.; Reig, H.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 8p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Several strains Brucela abortus, Salmonella typhimurium, and Escherichia coli were labeled with ^{131}I. McFarlane's technique, slightly modified, was followed and the radiochemical yield obtained was about 30 to 50%. The stability of the different labeled strains was studied. Antigenic stability of the labeled bacterial walls, was highly satisfactory. (auth)

21835 (BNL-18051) RADIOPHARMACEUTICAL KITS. Atkins, H. L. (Brookhaven National Lab., Upton, N. Y.). 1973. 16p. (CONF-730649-1). Dep. NTIS $3.00.

From 20th annual meeting of the Society of Nuclear Medicine; Bal Harbor, Florida, USA (11 Jun 1973).

Radiopharmaceutical kits fulfill a definite need in the practice of nuclear medicine. They make available short-lived radionuclide-labeled radiopharmaceuticals to laboratories where complex chemical manipulations are not feasible. This improves the quality of diagnostic techniques and at the same time can reduce radiation dose to the patient populations. The production of ^{99m}Tc using a ^{99}Mo generator is cited as an example. Still to be solved is the question of quality control. It would be useful if simple, standard procedures could be developed for each type of kit which would allow rapid testing prior to use. (CH)

21836 (CONF-721091-, pp R7.b1-R7.b5) APPLICATION OF RADIOISOTOPES AND NUCLEAR RADIATION AT THE FRUIT AND FRUIT TECHNOLOGY RESEARCH INSTITUTE. Haasbroek, F. J. 1972. (In Afrikaans).

From national conference on the technological applications of nuclear techniques, 1972; Pelindaba, South Africa (12 Oct 1972).

Facilities include a well-equipped radioisotope laboratory for tracer studies and a 5,000 Ci ^{60}Co irradiation unit for studies on the possible applications of gamma rays. Radioisotopes are mainly used at the FFTRI in connection with plant, water, and soil studies. The use of radioisotopes as tracers opened up several new research possibilities in agriculture. The isotopic dilution technique is employed for various purposes such as the determination of exchangeable and potentially available nutrients in the soil, apparent free space in fruit tissue and total body water of sheep. Interactions and relationships between the uptake of nutrient elements by plants are studied by employing more than one radioisotope simultaneously. By this means the layout of experiments is simplified and more reliable results are obtained. Various metabolic processes such as those involved in the rest-breaking of fruit trees are also studied. Labeled compounds are allowed to take part in these processes and compounds that become labeled are identified. Autoradiography plays an important role in the tracer studies and various laboratory techniques are employed to study the distribution of radioactivity in large biological samples and in single plant cells. These techniques are also used for special applications such as the determination of the rate of growth of pollen tubes in flower and wool fibres of sheep. A neutron soil moisture meter was designed and built. Special attention is given to factors affecting the field use and calibration of this instrument. Radiographic techniques are employed to determine the viability of plant seeds and to indicate internal rotting of the stems of fruit trees. In the field of food preservation, attention was given to the control by irradiation of micro-organisms causing post-harvest spoilage in apples, peaches, and strawberries. The inhibition of sprouting of potatoes and the effects of irradiation on protea blooms were studied. The possibilities of controlling insects in their natural environment by means of the sterile-male technique or by direct irradiation of fresh fruit is also

receiving attention with respect to insects such as the false codling moth and certains species of fruit flies. The ^{60}Co irradiation unit is further used for irradiation of seeds and buds and in mutation studies and other applications such as the sterilization of soil samples. (auth)

21837 (UR-3490-335) COMPUTER PROGRAMING APPLICATIONS IN NUCLEAR MEDICINE. Weber, D. A.; Wilson, G. A.; Keyes, J. W. Jr. (Rochester Univ., N. Y. School of Medicine and Dentistry). 1973. 18p. (CONF-730627-3). Dep. NTIS $3.00.

From third symposium on the sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

The digital computer in a nuclear medicine laboratory provides for: the processing and display of routine clinical images; the evaluation of radiopharmaceutical kinetics and dosimetry; quality control of instrumentation; radiopharmaceutical dosage preparation and inventory; and teaching. These applications are in addition to the basic capability to provide for programed computations in routine and research studies. The implementation of each of these systems capabilities within a nuclear medicine service can add significantly to the type, quality, and scope of studies which can be initiated. The methods used and the results gained from setting up and carrying out these operations on a 20K, 16 bit word computer are discussed. (auth)

21838 BASIC PRINCIPLES OF THE RADIOIMMUNOASSAY. Esztergalyos, J. Magy. Radiol.; 25: No. 3, 169-175(1973). (In Hungarian).

The basic principle of the radioimmunoassay is the use of a specific antigen-antibody reaction, combined with isotope labeling. An antibody of known quantity is mixed with a specimen, containing the antigen to be determined and the radioactive antigen of known quantity. After suitable incubation time an equilibrium of the labeled and not-labeled antigen-antibody mixture is formed. Since the endogenous and the labeled antigen are in competition in order to obtain the active component of the antibody, the quantity of the developed labeled complex is proportional with the antigen concentration of the unknown serum, giving its invert vector. The numerical value of the antigen concentration of unknown sera may be determined with the aid of a definite curve. Radioimmunoassay combines the specificity of the immunology and the sensitivity of the isotope technique. (auth)

21839 REACTION OF THE SKELETON AND BONE MARROW TO MALIGNANT TUMOURS OF THE TESTIS. Comparison and Evaluation of Results of Strontium (^{85}Sr) Test and Cytological Findings from Sternal Punctates in 44 Patients. Bek, V.; Hermanska, Z.; Kolar, J.; Abrahamova, J.; Jakoubkova, J. (Charles Univ., Prague). Neoplasma; 20: No. 2, 209-215(1973).

Skeletal and bone marrow reaction was followed in 44 patients with testicular tumors with the aid of the strontium (^{85}Sr) test of the skeleton and a simultaneous cytological investigation of the sternal punctate. A radioisotope investigation showed an abnormal rebuilding of bone tissue, particularly in the spine and the pelvis, in 75% of the patients, while changes in the marrow were observed in 95%. Malignant cell clusters were found in 12 patients (27%) with osteoclasts and osteoblasts being present in an even higher percentage. Nonspecific changes such as hyperplasias of the red cells, eosinophils, and plasma cells were detected in 30% of patients, but the most frequent nonspecific change was hyperplasia of the lymphoid reticulum (60%). The above changes in the skeleton and bone marrow are not considered, on the whole, as surprising in a group of 24 patients with a short survival period (an average of 20 months) and for the most part with clinically evident metastases. However, against all expectation, these changes were also found with an equally high percentage in a second group of 20 patients surviving over a relatively long time (an average of 11 yrs) who, with the exception of 2, were free of any clinical symptom of disease at the time of examination. The discussion bears on possible relationships between radioisotope findings on the skeleton and cytological findings in bone marrow, and further, on the possible immunobiological basis for the unexpected results in long-surviving patients. (auth)

21840 NUKLEARMEDIZIN. Einfuehrung in Theorie and Praxis. (Nuclear Medicine. Introduction in Theory and Practice). Deckart, H. Jena, Ger.; VEB Gustav Fischer Verlag (1973). 336p. 28,50 M.

Methods for the preparation of pharmaceuticals labeled with radioisotopes are discussed. Their clinical applications are then outlined. Special emphasis is placed on diagnostic techniques requiring a combination of clinical, laboratory, roentgenological, and nuclear medical methods. (HBG)

21841 RADIATION EXPOSURE OF THE PATIENT IN NUCLEAR MEDICINE. de Roo, M. (Univ., Louvain, Belgium). J. Belge Radiol.; 56: No. 2, 175-183(1973).

The detailed review of patient doses in nuclear medicine emphasizes the definitive contribution of the short-lived tracer substances in reducing the radiation risks of this exploration method. For the in vivo investigation of thyroid pathology, ^{99m}Tc or ^{132}I eliminated ^{131}I; for the evaluation of hormonosynthesis the in vitro tests are extremely reliable. Use of ^{51}Cr and ^{59}Fe in hematology still gives relative high doses to several organs. Isotope tests for exploration for renal function and vascularization are relatively safe. For scintigraphy only pancreatic scans seem to deliver high doses to the liver, kidney, pancreas, and spleen. For the other exploration methods adequate short lived tracersubstances are available. Nuclear medicine procedures are in most instances to be considered as innocuous with regard to radiation exposure of the patients. (auth)

21842 DIRECT PROGESTERONE RADIOIMMUNOASSAY. Castro, A.; Kutas, M.; Chung, A.; Bartos, D. (United Medical Labs., Portland, OR). Experientia; 29: No. 5, 636-637(15 May 1973).

A method for radioimmunoassay of progesterone without chromatographic purification is described. The 11-hemisuccinate of progesterone was joined to bovine serum albumin and injected into rabbits to stimulate production of antibodies. Samples of human plasma, extracted with ether, were added to given quantities of 1,2-^{3}H-progesterone. The results with or without chromatography are comparable. The method is precise and very sensitive for measuring slightly elevated levels of human progesterone. (tr-auth)

21843 CURRENT STATUS OF STANDARDIZATION OF STEROID RADIOIMMUNOASSAY. Malvano, R.; Rosa, U. (National Research Council, Pisa, Italy). J. Nucl. Biol. Med.; 16: No. 2, 90-101(1972).

Some problems connected with the development of suitable RIA procedures for the steroid hormones are briefly reviewed using as an example the results obtained for testosterone, progesterone, aldosterone, and estradiol. The dependence on the characteristics of the antiserum actually available of the assay possibilities and limitations is shown, and the requirement of optimizing accordingly the experimental parameters is discussed. Some results obtained by using ^{125}I-labelled TME-steroid derivatives as a tracer are reported as well. (auth)

21844 EXPERIMENTAL EVALUATION OF SCANNING AGENTS FOR TUMOR LOCALIZATION. De Roo, M. J. K. (Catholic Univ., Louvain, Belg.). J. Nucl. Biol. Med.; 16: No. 2, 62-72(1972).

The exploration of tracer accumulation in different organs and tissues in tumor-bearing animals (Sprague-Dawley rats with DMBA induced mammary tumors) permitted to select some radioactive substances useful for detection and visualization of tumors. Gallium-67 labeled citrate and ^{75}Se-sodium selenite seemed to correspond to the given criteria of high tumoral accumulation and positive tumor to blood ratio. Eventually ^{99m}Tc-Fe-complex could also be used for isotopic localization of malignant growth. However, results are only available for one specific tumoral localization and therefore should be considered only as an interesting random test. The fact that hemorrhage and necrotic degeneration inhibit tracer accumulation within the tumor and that tumor tracers concentrate readily in nonmalignant lesions (infection, necrosis), makes selective detection of malignancies by medical tracer techniques improbable, at least using the tracer substances so far available. (auth)

21845 CONTINUOUS LABELING OF MAMMALIAN DNA IN VIVO. Russev, G. C.; Tsanev, R. G. (Biochemical Research Lab., Sofia). Anal. Biochem.; 54: No. 1, 115-119(Jul 1973).

A simple technique is described for continuous labeling of mammalian DNA with radioactive precursors adsorbed onto activated charcoal and administered by a single intraperitoneal injection. It is shown that adsorbed labeled thymidine is available in the organism for incorporation into DNA for at least 50 hr. The same technique can be used to substitute up to 20% of the thymidine with 5-bromodeoxyuridine in regenerating rat liver. (auth)

21846 TOTAL-BODY POTASSIUM DURING THE FIRST YEAR OF LIFE DETERMINED BY WHOLE-BODY COUNTING OF ^{40}K. Novak, L. P. (Mayo Clinic and Mayo Foundation, Rochester, MN). J. Nucl. Med.; 14: No. 8, 550-557(Aug 1973).

Total-body potassium was determined by whole-body counting of ^{40}K in 31 white, normal infant boys and in 33 infant girls at 1, 4, 9, and 12 months of age. Anthropometric measurements of skeletal growth, subcutaneous fat, and lean tissues supplemented measurements of total-body potassium. Infant boys had significantly higher amounts of total-body potassium at each age. Amounts of total-body potassium per kilogram of

body weight were nearly the same in both sexes at all ages, except a decrease in relative amounts was observed at age 4 months in both sexes. The correlation coefficient between total-body potassium and chronologic age in infant boys and girls was 0.94 and 0.89, respectively; the correlation coefficient of total-body potassium with weight was 0.93 and 0.92, respectively. In relation to height, two intersecting regression lines showed the breaking point of total-body potassium at about 59.8 cm for infant boys and at about 64.3 cm for infant girls. (auth)

21847 RECTAL ABSORPTION OF ^{99m}Tc-PERTECHNETATE IN THE DOG. Caride, V. J. (Yale Univ., New Haven). J. Nucl. Med.; 14: No. 8, 600-603(Aug 1973).

As a prerequisite of the utilization of $^{99m}TcO_4^-$ as a tracer to study the rectal-to-hepatic vascular pathways, the dynamics of its rectal absorption in dogs was analyzed. Activity was recorded over the rectal area and over the heart with a dual-probe system. Pertechnetate was absorbed from the rectal lumen with a $t_{\frac{1}{2}}$ = 1.41 ± 0.57 for its first component. The second component did not show any appreciable slope. (auth)

21848 RADIOLANTHANIDES AS PROMISING TUMOR SCANNING AGENTS. Hisada, K.; Ando, A. (Kanazawa Univ., Japan). J. Nucl. Med.; 14: No. 7, 615-617(Aug 1973).

Based on the previous findings that some of the elements in the Group III and in the Period VI of the periodic table have a tumor affinity, the presence and extent of tumor affinity of radiolanthanides were examined using Yoshida sarcoma-bearing rats. Results indicated that all eight elements tested show some affinity for a tumor. Thulium-170 and ^{169}Yb are nuclides that can favorably compare with that of ^{67}Ga. Discovery of other good nuclides was discussed. As a promising nuclide for clinical tumor scanning, ^{167}Tm, ^{169}Yb, and ^{175}Yb (citrate form is preferable) were suggested. (auth)

21849 INTERPRETATION OF ^{99m}Tc SUPERIOR VENA CAVOGRAMS AND RESULTS OF STUDIES IN 92 PATIENTS. Miyamae, T. (Tokyo Univ.). Radiology; 108: No. 2, 339-352(Aug 1973).

Superior vena cavography, using ^{99m}Tc, was performed in 92 patients including 45 with superior vena caval obstruction caused by malignant tumors or inflammatory disease and 47 normal subjects. As an aid in the intepretation of findings seen on the ^{99m}Tc vena cavogram, 27 patients with obstruction also underwent contrast medium vena cavography. Normal variants seen on the ^{99m}Tc cavogram included collateral pathways accompanying superior vena caval obstruction, observation of the pulmonary circulation phase, and determination of transit time from the antecubital vein to the right heart. Radionuclide vena cavography is suggested as a simple safe procedure for initial screening for superior vena caval obstruction and follow-up studies. (auth)

21850 MEASUREMENT OF SERUM FOLATE LEVELS AND SERUM FOLIC ACID-BINDING PROTEIN BY ^{3}H-PGA RADIOASSAY. Waxman, S.; Schreiber, C. (City Coll., New York). Blood; 42: No. 2, 281-290(Aug 1973).

A radioassay for the measurement of serum folate levels using commercially available beta lactoglobulin, as the folate-binding protein, and ^{3}H-pteroylglutamic acid (^{3}H-PGA) is reported. The assay was run in a one-step simultaneous addition at room temperature. A standard curve was constructed to a sensitivity of 0.25 to 10 ng of N-methyltetrahydrofolic acid (methyl-THFA). There was a clear correlation with separation into normal (greater than 6 ng/ml), indeterminate range (3 to 6 ng/ml), and deficient (0 to 3 ng/ml), as measured by radioassay. Serums from patients receiving antibiotics had normal folate levels with this assay. ^{3}H-PGA was also used to measure serum folic acid-binding protein (FABP). In normal serums, the mean FABP was 18 pg bound/0.4 ml serum, while in folate-deficient serums it was 133 pg bound/0.4 ml of serum. Folate-deficient patients had a fall in serum FABP to the normal range when treated with folic acid. Serum FABP, in a patient on a folate-deficient diet, increased with early folate deficiency and abruptly fell to normal with a regular diet. FABP in lysates of folate-deficient bone marrow was higher than normal marrow. Patients with B_{12} deficiency, multiple myeloma, cirrhosis, pregnancy, or taking oral contraceptives had normal FABP. Elevated FABP was found in two out of ten patients taking Dilantin. This radioassay and the measurement of FABP should simplify the diagnosis of folate deficiency. (auth)

21851 NUCLEAR MEDICINE IN DANISH HOSPITALS 1971–1972: STATISTICAL INFORMATION. Rosenkjaer Ennow, K.; Kristensen, K. Fra Sundhedsstyr.; 6: No. 9, 97-100(1973). (In Danish).

Detailed information is given on the use of radiopharmaceuticals in Danish hospitals for the fiscal year 1971/72. The number of tests increased from approximately 19,000 in 1967/68 to approximately 37,000 in 1971/72. The number of scintigraphic examinations increased in the same period from 2,400 to approximately 13,000. (auth)

21852 BASIC STUDY AND CLINICAL EVALUATION OF EFFECTIVE THYROXINE RATIO BY MEANS OF A NEW IN VITRO THYROID FUNCTION TEST, RES-O-MAT ETR TEST. Mori, T.; Kousaka, T.; Hamada, S.; Takeda, Y.; Ikekubo, K. (Kyoto Univ.). Nippon Naibunpi Gakkai Zasshi; 48: No. 9, 685-697(Dec 1972). (In Japanese).

The test procedure of Res-O-Mat ETR test is described. The effect of incubation temperature and time can be minimized and reproducibility is considerably high. ^{125}I-thyroxine (T_4) resin uptake is determined by T_4/thyroxine binding globulin (TBG) ratio in the vial and TBG abnormality is corrected by the addition of sera (0.005 ml) to represent proper thyroid function. The results of clinical application to 239 cases including hyperthyroidism, hypothyroidism, euthyroidism, and pregnancy indicated that in all conditions ETR proved to correspond fairly well with other clinical findings. The relation between free thyroxine index (FTI) and ETR was 0.916. The comparative studies on ^{131}I-triiodothyronine (T_3) resin uptake (T_3RU), FTI and serum thyroxine concentration (T_4) indicated that the relation between T_3RU and T_4 is rather weak (=0.713) whereas those between ETR and T_3RU and T_4 are both close, the values being 0.861 and 0.896 respectively. This leads to consider that ETR is provided with T_4 element and free TBG capacity and therefore a useful measure of FTI. The relations between various test results and calculated FTI in hyperthyroidism, hypothyroidism, euthyroidism, and pregnancy were also studied. ETR was not effective in hyperthyroidism indicating no relation of significance with FTI. On the other hand, ETR proved to be a proper representation of thyroid function in Basedow's disease in pregnancy and ^{131}I-treated Basedow's disease where free TBG capacity and T_4 are not useful. (JA)

21853 CLINICAL MYOCARDIAL IMAGING WITH NITROGEN-13 AMMONIA. Harper, P. V.; Schwartz, J.; Beck, B. S.; Lathrop, K. A.; Lembares, N.; Krizek, H.; Gloria, L.; Dinwoodie, R.; McLaughlin, A.; Stark, V. J.; Bekerman, C.; Hoffer, P. B.; Gottschalk, A.; Resnekov, L.; Al Sadir, J.; Mayorga, A.; Brooks, H. L. (Univ. of Chicago). Radiology; 108: No. 3, 613-617(Sep 1973).

Myocardial infarcts may be clearly imaged using intravenous nitrogen-13 as carrier-free ammonia in doses of 10 to 30 mCi. This positron emitter is well imaged with the Nuclear Chicago HP Anger Camera with heavy collimation. The rapid blood disappearance of the agent gives good image contrast, and the short half-life and high isotope dosage give high-count density images with little radiation absorbed dose (5 mrad/mCi total body). (auth)

21854 SCINTISCANNING TUMORS USING ^{169}Yb-CITRATE. Hisada, K. (Kanazawa Univ., Japan); Hiraki, T.; Ando, A. Rinsho Hoshasen; 18: No. 3, 191-194(Mar 1973). (In Japanese).

Ytterbium-169-labeled citrate was administered intravenously in the dose of 500 μCi per patient, and radioactivity was detected by a Pho/Gamma III scinticamera. The result of ^{169}Yb-citrate application to 41 clinical cases showed that ^{169}Yb-citrate was satisfactory in detection of radioactive distribution for positive delineation of the tumor. The rate of positivity was 90% in 10 cases of lung cancer, 63.6% in 11 cases of liver cancer, and 73.5% in the 34 cases of metastatic malignant tumor. The result of scinti-image by use of ^{169}Yb-citrate was compared with that of ^{67}Ga-citrate. The merits of the use of ^{169}Yb are: (1) the half life is 32 days; (2) positive tumor image is distinctively observed within 2 to 5 days, and higher radioactive retention in the skeletal lesion can be detected; (3) it is obtainable easily and inexpensively; and (4) it does not emit β-ray, and gamma radiation is suitable for scinti-imaging. However, uptake by the bones is apt to be higher with the use of ^{169}Yb and it is difficult to detect the lesion around the bones. The dose administration should be well controlled according to age and type of disease of patient. (JA)

21855 CLINICAL STUDY BY COMPUTER PROCESSING OF RENOSCINTIGRAMS. Miki, M.; Machida, T.; Ueda, M.; Kido, A.; Minami, T. (Jikei Univ., Tokyo). Nippon Hinyokika Gakkai Zasshi; 64: No. 2, 163-174(Feb 1973). (In Japanese).

The apparatus used is a new digital data processing system. It is assembled of the following components: a data acquisition unit, a data display unit with a light-pen, a central processing unit having an 8 kiloword core memory (1 word = 24 bits), a direct memory access channel, a high-speed burst channel, a magnetic drum (100 kilowords), a high-speed digital magnetic tape recorder, and a teletypewriter. The apparatus is capable of continuously recording at certain time intervals up to 100 frames of radioisotope image changes with time. The collected data are reproduced on an oscilloscope for smoothing, three-dimensional display, and drawing profile curves. With regard to

any given region of interest, changes of radioactivity can be expressed in curves that are called a regional renogram. Radioisotopes used were 200 μCi of ^{203}Hg-chlormerodrin, 200 μCi of ^{131}I-hippuran, and 4-10 mCi of Na $^{99m}TcO_4$, and 1 or 2 kinds of them were selected depending on the case. About 10 to 40 frames of scintigrams were obtained at 5 to 90 second intervals immediately following intravenous injection. Sixteen cases with space occupying lesions were examined and five cases were explained in detail. Processing and studying of these data gave the following findings. (1) From the profile curves, split renal and regional functions can be appraised semiquantitatively. (2) Changes of radioactivity with time in any given region of the kidney can be obtained as what may be called regional renogram. (3) The three-dimensional display enables cold areas to be readily located. (4) Renal lesions can be discriminated by selective use of various radioisotopes and adjusting programs. (auth)

21856 BASIC STUDY AND CLINICAL RESULT OF TUMOR DETECTION USING ^{99m}Tc-LABELLED BLEOMYCIN. Mori, T.; Hamamoto, K.; Torizuka, K. (Kyoto Univ.). Rinsho Hoshasen; 18: No. 3, 201-205(Mar 1973). (In Japanese).

Metastable technetium-99-labelled bleomycin was administered intravenously to the fibrosarcoma-bearing mouse. Progressive changes in radioactivity in the organ of the mouse were investigated. The retention rate of radioactivities in the whole body was less than 1/6 of the total administered doses after 24 hrs. One percent retention of radioactivities was observed after 30 min and 0.58% was observed even after 24 hrs in the tumor lesion. Results of ^{99m}Tc-bleomycin application to 107 clinical cases of tumor diseases were compared with those of ^{67}Ga-citrate application. In the scintigram of malignant tumors, detection rate was 95% by use of ^{99m}Tc-bleomycin and 92% by use of ^{67}Ga-citrate. In the control group, the detection rate was 29% false positive by use of ^{99m}Tc-bleomycin and 69% false positive by use of ^{67}Ga-citrate. Metastable technetium-99 has a half-life of 6 hrs which makes it possible to give a large dose at single administration with less exposure dose. Metastable technetium-99 is considered one of the most useful radioisotopes for the detection of the tumor lesion. (JA)

21857 RADIOIMMUNOASSAY OF PLASMA RENIN ACTIVITY. Comparison of Skinner Modification Method with Bioassay. Nishizawa, C.; Miyamori, I.; Hasatani, K.; Uchida, K.; Morimoto, S. (Kanazawa Univ., Japan). Horumon To Rinsho; 20: No. 11, 791-975(Nov 1972). (In Japanese).

Samples of heparinized blood were obtained from the antecubital vein of fasting patients in the early morning after giving 12 g saline per day. Further samples were obtained from the antecubital veins and from both renal veins 4 hrs after giving 80 mg furosemide. The plasma, dialyzed by the Skinner modification method, was divided into two groups in order to measure its renin activity. One group was measured by the radioimmunoassay (RIA) using the antiserum of Angiotensin I (Ang I) and ^{125}I-Ang I. 8-Hydroxyquinolin (8-HQ) and Dimercaprol (BAL) were then added to the RIA. The second group was measured by bioassay (BA). The measured values of plasma renin activity obtained by the BA and the RIA showed a significant relationship with a correlation coefficient $t = 0.895$. The values from patients with primary aldosteronism and Cushing syndrome were generally within a range of 0.5 to 8.0 ng/ml/h by both methods while those from patients with Addison's disease and malignant hypertension showed scattered values wider range than that of 10 ng/ml/h. Inactivation of converting enzymes was examined using plasma that showed high values: (1) using only the Skinner method group, and (2) the same group after adding 8-HQ and BAL. In group (1), Ang I was 80.9% and Ang II was 69.1%, showing incomplete inactivation. In group (2), Ang I was 73.4% and Ang II was 6.6%, which seemed to indicate complete inactivation. The recovery rate of Ang I was 86.2%. The comparison of pressor activity between nonradioactive Ang I and Ang II standards showed that pressor activity varied largely with the measurement kit and it decreased with time. This fact seems to suggest that the kit nonradioactive Ang I standard is unstable. (JA)

21858 STUDIES ON ALIMENTARY BLOOD LOSS AND ERYTHROCYTE HALF-LIFE IN INFANTS AND CHILDREN USING ^{51}Cr-LABELED ERYTHROCYTES, 1. Nomura, T. (Nippon Medical School, Tokyo). Nippon Shonika Gakkai Zasshi; 76: No. 6, 363-367(Jun 1972). (In Japanese).

A series of studies was conducted in order to investigate the normal range of alimentary tract hemorrhage in infants and children. Alimentary tract bleeding, erythrocyte half-life, circulating blood volume, and circulating erythrocyte volume were studied using ^{51}Cr-labeled erythrocytes in 10 normal subjects and 8 subjects with subnormal erythrocyte values. All subjects were in the course of recovery from various diseases. Clinical diagnosis of the subjects included physiologic anemia, trauma, hepatitis, infectious mononucleosis, purpura nephritis, nephritis prolongata, Wilson's disease, and aplastic anemia. The age of the subjects ranged from 2 months to 16 years old. Alimentary tract bleeding in normal subjects was 0.06 ± 0.03 ml/kg/day in contrast to 0.09 ± 0.06 ml/kg/day of the subnormal subjects, indicating no difference of significance. Accordingly, the average normal value was obtained as 0.07 ± 0.03 ml/kg/day. Half-life span of ^{51}Cr-erythrocytes was 26.2 ± 4.2 day. Circulating blood volume measured by ^{51}Cr-dilution method was found to be 84.34 ± 15.81 ml/kg. Circulating erythrocyte volume was 29.71 ± 6.14 ml/kg. A brief review of the pertinent literature was also given in the course of discussion. (JA)

21859 RADIOIMMUNOASSAY FOR TRIIODOTHYRONINE IN HUMAN SERUM. Huefner, M. (Medizinische Universitaets Poliklinik, Heidelberg); Hesch, R. D. Acta Endocrinol.; 72: 464-474(1973).

A radioimmunoassay for triiodothyronine (T_3) is demonstrated. Details of the T_3 antibody binding reaction are discussed and the statistical data of the assay system are presented. Plasma samples were first extracted by a simple ion exchange method and the extracts then tested by radioimmunoassay. The mean normal concentration was 1.35 ± 0.29 ng/ml. Later, direct measurements in serum samples were performed after partial inhibition of T_3 binding to TBG by merthiolate and high pH buffer. After correction for the residual non-specific binding a mean normal plasma level of 1.2 ± 0.3 ng/ml was obtained. (auth)

21860 SIMPLE TECHNIQUE FOR MEASURING THYROXINE SECRETION RATE IN THE MOUSE. England, P.; Webb, J.; Harland, W. A. Whaley, K. (Western Infirmary, Glasgow). Acta Endocrinol.; 72: 438-442(1973).

Thyroxine secretion rates in mice may be estimated by a single bleed following injection of a tracer dose of radiothyroxine. Assumptions inherent in the procedure under different experimental conditions are discussed and validated at several environmental temperatures. (auth)

21861 METHOD OF SYNTHESIZING ^{131}I-19-IODOCHOLESTEROL FOR ADRENAL SCANNING AND ITS CLINICAL USAGE. Kojima, M.; Yamaguchi, T.; Maeda, M.; Iwase, Y.; Sakato, M. (Kyushu Univ., Fukuoka). Horumon To Rinsho; 21: No. 3, 331-335(Mar 1973). (In Japanese).

19-Iodocholesterol was synthesized by the method of Kalvoda, Barton, and Blair et. al. after synthesizing 19-dihydroxy-cholest-5-ene-3-acetate, 3β-19-dihydroxy-cholest-5-ene-3-acetate-19-toluene-p-sulfonate, and 3β-19-dihydroxy-cholest-5-ene-19-toluene-p-sulfonate from 3β-hydroxycholest-5-ene-3-acetate. The exchange reaction rate of 19-iodocholesterol and ^{131}I was 90%, and ^{131}I-19-iodocholesterol with a specific radioactivity of 1 mCi/mg was synthesized. Acute toxicity tests in which 19-iodocholesterol was administered intravenously to mice showed no toxicity even for doses of 33 mg/kg. Aseptic tests of ^{131}I-19-iodocholesterol solution for bacteria and mycosis were negative. In addition, pyrexial substance tests were negative for even five times the normal administered dose. When ^{131}I-19-iodocholesterol was administered to man, biological half life and effective half life were 6.60 and 3.62 days, respectively. Three cases were exposed to a mean dose of 2.13 rad per 1 mCi. The drug was administered to cases with primary aldosteronism and Cushing syndromes, with no observable effects or signs of disturbance by radiation, even 3 months after administration. The location of the adrenal tumor was precisely confirmed by single intravenous administration, showing ^{131}I-19-iodocholesterol to be effective in the diagnosis of cases of primary aldosteronism and Cushing syndromes. (JA)

21862 DEMONSTRATION OF ECTOPIC GASTRIC MUCOSA BY RADIOACTIVE PERTECHNETATE. Sommerschild, H. C.; Rootwelt (Rikshospitalet, Oslo). Tidsskr. Norske Laegforen.; 93: No. 15, 1151-1153(30 May 1973). (In Norwegian).

Radioactive ^{99m}Tc-pertechnetate is actively concentrated in the gastric mucosa, whereby the gastric mucosa proper as well as ectopic mucosa may be visualized scintigraphically. Such scintigraphy was performed in five patients on whom operations were also performed. In three patients, neither scintigraphy nor laparotomy showed any abnormality. In two patients, the operation disclosed ectopic gastric mucosa, and in one of these cases the scintigraphs were distinctly pathologic as well, whereas in the other patient the scintigraphs were equivocal. In the latter case, a Meckel's diverticulum measuring 0.7 × 1.2 cm was present. The method is recommended for investigation of patients with enteric blood loss of unknown etiology. It is painless, is completely without risk, and gives only a small radiation dose to the patients. The method is particularly well suited for investigation of children. Provided perchlorate blockage is not given and a

γ camera is used, injection of 30 μCi pertechnetate/kg body weight is sufficient for imaging. (auth)

21863 PREPARATION OF A MACROAGGREGATE OF ^{99m}Tc-SULFUR COLLOID AND HUMAN ALBUMIN FOR LUNG SCINTIGRAPHY. Braenne, H.; Fagerli, M.; Rokkones, T. (Fylkessjukehuset, Aalesund, Norway). Medd. Norsk Farm. Selsk.; 35: No. 1-2, 1-7(1973).

The procedure for making macroaggregates of ^{99m}Tc-sulfur colloid and human serum albumin by a modified Cragin method is described. The preparation time is about 10 min, and the procedure is so standardized that it can be carried out without special practice. The effect of pH on particle size distribution, particle concentration, and percentage of ^{99m}Tc bound to the particles is discussed. (auth)

21864 INFLUENCE OF HEPARIN-PLASMA, EDTA-PLASMA, AND SERUM ON THE DETERMINATION OF INSULIN WITH THREE DIFFERENT RADIOIMMUNOASSAYS. Thorell, J. I. (Univ. of Lund, Sweden); Lanner, A. Scand. J. Clin. Lab. Invest., Suppl.; 31: No. 2, 187-190(Mar 1973).

Insulin was measured with three radioimmunoassay method, with double antibody precipitation (DA), ethanol precipitation (EP), and solid-phase linked antibody (SP), respectively, on samples of serum and plasma, with heparin or EDTA as anticoagulants. EP and SP methods gave almost identical results for all forms of samples. Higher values were found with the DA method on heparin plasma. This effect disappeared at low concentrations of heparin. It is concluded that the presence of heparin only affects radioimmunoassays for insulin involving DA precipitation. (auth)

21865 SENSITIVE ASSAY FOR THE DETERMINATION OF DOPAMINE IN PLASMA. Christensen, N. J. (Kommunehospitalet, Aarhus, Denmark). Scand. J. Clin. Lab. Invest., Suppl.; 31: No. 3, 343-346(May 1973).

A sensitive double-isotope derivative technique for the determination of dopamine is described. It is based on the formation of the 3-0-methyl derivative of dopamine in the presence of a ^{14}C-labeled methyl donor and the enzyme catechol-0-methyl transferase. The recovery in each sample is calculated from ^{3}H-labeled dopamine. The dopamine concentration averaged 0.20 ng/ml ± 0.06 (± S. D.) in venous blood obtained from six normal subjects who rested in the supine position. The 24-hr urinary excretion of dopamine was 207 and 297 g in two normal subjects. The technique may also be suitable for measurement of dopamine in spinal fluid. (auth)

21866 BRONCHIAL ANGIOSCANOGRAPHY WITH $^{197}HgCl_2$ AND THE RELATIONSHIP BETWEEN THE BRONCHIAL ARTERIOGRAM AND THE PATTERN OF THE SCINTIGRAM IN LUNG CANCER. Fujii, T. (Shinshu Univ., Nagano, Japan). Nippon Kyobu Rinsho; 31: No. 11, 914-923(Nov 1972). (In Japanese).

The bronchial angioscanography with $^{197}HgCl_2$ was applied to lung cancer, and the relation between the distribution of this isotope in the lesion and the pattern of the bronchial arteriogram was studied. As the angioscanography with this isotope gave higher and more localized concentration than the intravenous scanography, the former was thought to be a more available method. The grade of concentration of this isotope seemed to be correlative with the bronchial vascularity of the lesion. In the first report, it was also proved that $^{197}Hg^{++}$ was combined with the plasma protein in large quantities, and thus this isotope might transude from the vessels by the augmented permeability due to the disease process, and the increased bronchial blood flow would promote this process. These might be the first step for the isotope to concentrate in the tumor lesion, and a similar mechanism might occur in the inflammatory lesion. (auth)

21867 DEVELOPMENT OF RADIOISOTOPE-LABELED ONCOTROPIC COMPOUNDS. 6. Affinity of ^{57}Co-Bleomycin for Tumor. Maeda, T. (National Hospital of Kyushu Cancer Center, Fukuoka); Kohno, A.; Kojima, M. Radioisotopes (Tokyo); 21: No. 8, 498-501(Aug 1972).

Cobalt-57-labeled Bleomycin (BLM) has an affinity for tumor. There is little possibility that the affinity for tumor of ^{57}Co-BLM is due to vascularity of tumors or any secondary change in the adjacent tissues. Fundamental studies have demonstrated the uptake of this radioactive substance by tumors. It appears that a most suitable time for positive detection of tumors is from 24 to 48 hrs after the administration of ^{57}Co-BLM. The results of the study suggest the dissimilarity of ^{57}Co-BLM to BLM (copper-free) in properties and, moreover, the lesser toxicity of the former substance. All these results, including data relevant to exposure dose, may be considered to warrant the clinical use of ^{57}Co-BLM. (auth)

21868 DEVELOPMENT AND PREPARATION OF RADIOPHARMACEUTICALS. Kloss, G.; Bremer, K. H.; Fruehauf, K. (Farbwerke Hoechst AG, Frankfurt am Main). Therapiewoche; 23: No. 18, 1593-1598(1973). (In German).

Insight into the problems of the production of radiopharmaceuticals and their application in medical diagnostics and therapy is given. (GE)

21869 QUALITY CONTROL OF RADIOPHARMACEUTICALS. Pechtold, F. (Farbwerke Hoechst AG, Frankfurt am Main). Therapiewoche; 23: No. 18, 1600-1605(1973). (In German).

A survey is given of the problems of a quality control of radiopharmaceuticals. The correct composition is controlled by physical, chemical, and biological tests. Particular emphasis is placed, of course, upon the control of the final products just before dispatching them. But, in addition, control of the auxiliary materials and basic preparations are necessary. Besides these, additional tests during and after the run of a charge are the presupposition for guaranteeing the quality of radiopharmaceuticals. (GE)

MATERIALS

21870 (CONF-720226-(Absts.)) SYMPOSIUM ON CRYSTALLOGRAPHY, BOMBAY, FEBRUARY 23–25, 1972. Programme and Abstracts. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 84p.

The program includes sections on biological structures, methods for structure determination, theoretical crystallography and computing, organic structures, polytypes and crystal growth, experimental techniques and defect structures, and inorganic and metallic structures. Seventy-one abstracts of the papers are included together with an author index. (DLC)

21871 MAGNETIC INTERACTIONS IN SOLIDS. Zeiger, H. J.; Pratt, G. W. International Series of Monographs on Physics. Oxford; Clarendon Press (1973). 660p..

The subject is dealt with in chapters: the magnetic Hamiltonian (including electromagnetic interactions); the magnetic properties of one-electron atoms (hydrogenic atoms); the magnetic properties of many-electron systems (atoms and ions); magnetic properties of ions in crystal fields (including the effects of covalence); band electrons in a magnetic field (including topics such as Landau levels, cyclotron resonance, the de Haas–van Alphen effect, and coupling to both magnetic fields and lattice vibrations); P.π perturbation theory and the effective mass approximation; impurity states and excitons in a magnetic field; indirect interactions in metals. It is stated that it is not the intention of the book to cover the more traditional topics in magnetism such as ferro-, ferri-, and antiferromagnetism, spin waves, or domain structure. (UK)

21872 SELECTIVE MODULATION OF RECOILLESS γ RAYS. Hannaford, P.; Horn, R. G. (Commonwealth Scientific and Industrial Research Organization, Clayton, Australia). J. Phys., C (London); 6: No. 13, 2223-2233(9 Jul 1973).

A technique applicable to Moessbauer spectroscopy enables the recoilless γ rays to be effectively isolated from other radiation emitted from the source, and yields absorption spectra which have improved stability and resolution, at the expense of some loss in signal-to-noise. The technique is particularly suitable for the accurate determination of absolute values of absorber recoilless fractions. Results are presented for the 23.9-keV ^{119}Sn γ rays emitted by a $BaSnO_3$ source. The recoilless fraction for a $BaSnO_3$ absorber at 295°K is found to be 0.57 ± 0.02. (auth)

21873 BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS. Volume 15, No. 4, Oct–Dec 1971. Hocking, M. G. (ed.). Washington, DC; International Union of Pure and Applied Chemistry (1971). 247p.

References are included on devices for achieving temperatures above 1500°C; devices for measuring and controlling temperatures above 1500°C; devices for physical measurements at temperatures above 1000°C; thermodynamic properties, at temperatures below 1000°C, of materials which melt above 1500°C; properties, at temperatures above 1000°C, of materials which melt above 1500°C; properties, at temperatures above 1000°C, of materials which melt below 1500°C; phase equilibria above 700°C; reactions at temperatures above 700°C; spectroscopy of interest to high-temperature chemistry; and reaction between gases and condensed phases. (About 900 references.) (JRD)

21874 THERMAL CONDUCTIVITIES OF THE ELEMENTS. Results of a Critical Evaluation. Powell, R. W.; Touloukian, Y. S. (Purdue Univ., Lafayette, IN). Science; 181: No. 4104, 999-1008(14 Sep 1973).

The late 1970 compilation and evaluation of the Thermophysical Properties Research Center of Purdue Univ. are discussed and compared to the thermal conductivity data from the Metals Handbook edition published in 1961; the largest changes (e.g., for C from 0.24 to 0.057–19.6 W cm^{-1} $°K^{-1}$) are tabulated. Elements lacking experimental data are also tabulated. Plots of thermal conductivity vs atomic number are given together with a periodic table showing thermal conductivities at 300°K and Debye temperature. The nature of the thermal conductivity (lattice, electronic, etc.) is discussed, and a detailed thermal conductivity–temperature plot is given for aluminum samples of varying resistivities and purities. Needs for further measurements are discussed at length for each element and by temperature range. (2 tables, 5 figures, 37 references) (DLC)

21875 ELEKTRONNYE I IONNYE PROTSESSY V TVERDYKH TELAKH. V. (Electron and Ion Processes in Solids. V). Tbilisi, USSR; Izdatel'stvo Metsinereba (1973). 220p.

Studies on radiation physics, physics of crystals with defects, oscillations, and EPR spectra, and heat properties of ionic crystals, as well as the low-temperature processes of metals and semiconductors were compiled. The experimental studies included effects of radiation on strength and ductility, metallic and quasi-metallic centers, kinetics of the accumulation of point defects, and conductivity and oscillation spectra of ionic crystals. A significant part of the studies was devoted to experimental and theoretical investigation of the static and dynamic properties of dislocations and point defects, their formation, interaction, migration, and thermal transitions. The theoretical investigations were devoted to the low-temperature properties of metals with impurities, electric phenomena in ionic crystals with defects, plastic properties of metals, and effects of tunneling in metals and of contraction in semiconducting plasmas. (tr-auth)

Ceramics and Cermets

Refer also to abstracts 20763, 21448, 21964, 22012, 22073, 22713, 23417, 23436, 23437, 23471–23481, 23514, 23558–23561, 23687, 23965, 23967, 23985, 23996, and 24072.

21876 (ANL-8020) CHEMICAL ENGINEERING DIVISION REACTOR SAFETY AND PHYSICAL PROPERTY STUDIES SEMI-ANNUAL REPORT, JANUARY–JUNE 1973. Chasanov, M. G.; Fredrickson, D. R.; Gabelnick, S. D.; Leibowitz, L.; Levenson, M.; Vogel, R. C.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill.). Jun 1973. Contract W-31-109-eng-38. 14p. AT.

The report includes the following: results for the measurement of the enthalpy of sodium from 500 to 1300°K; matrix-isolation studies of infrared spectra of CeO_2; viscosity data for molten basalt to 1950°C; information on the development of equipment to measure the thermal diffusivity of molten UO_2 and to determine the density of molten solutions of UO_2 in basalt; and information of the progress of measurements of enthalpies of molten mixed oxides. (auth)

21877 (CEA-CONF-2299) PHYSICAL PROFILE MEASUREMENTS IN INSULATING LAYERS USING THE ION ANALYSER. Bernard, J.; Combasson, J. L.; Guernet, G.; Hilleret, N.; Bruel, M. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 25 Jan 1973. 19p. (CONF-721226-1). Dep. NTIS (U. S. Sales Only) $3.00.

Boron-implanted distributions in insulating layers (SiO_2, Si_3N_4, or Si) were investigated using the ion analyzer. It is shown that, in some cases, profiles can be dissymmetric for energies greater than ~60 keV in silicon dioxide, and this conclusion seems to be in good agreement with Winterbon recent results. Nuclear reaction analysis also support this conclusion and an Edgeworth fit shows that the modal range in these cases is always greater than the average penetration depth. These results emphasize that the ion analyzer is a very powerful tool for studying range profiles in insulating layers including composite layers. (9 figures) (auth)

21878 (CONF-730721-1) EUROPIA DEVELOPMENT: STATUS AND PLANS. Donnelly, R. G. (Oak Ridge National Lab., Tenn.). [nd]. 21p. Dep. NTIS $3.25.

From meeting on LMFBR/FFTF control elements; Richland, Washington, USA (23 Jul 1973).

The status of Eu_2O_3 development for control rod applications is presented graphically and tabularly. Similar presentations are included to represent the plans being made for optimum use of this oxide. The plans are based on cost and availability, phase stability, compatibility, thermal conductivity, density, nuclear worth, and irradiation stability. (JRD)

21879 (EIR-238) HIGH-TEMPERATURE REACTION OF URANIUM CARBIDES AND TRANSIENT METAL CHLORIDES IN MOLTEN CHLORIDE MEDIA. Taube, M.; Strejcek, J.; Dietler, F. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jun 1973. 48p. Dep. NTIS (U.S. Sales Only) $4.50.

The reaction of UC with molten metal chlorides ($AlCl_3$, $ZnCl_2$, $CdCl_2$, $HgCl_2$, $MnCl_2$) in molten alkali chlorides (NaCl, KCl, RbCl, CsCl and eutectics NaCl/KCl, NaCl/$CaCl_2$) between 600 to 970°C in sealed silica ampules was investigated. The kinetics (half time of dissolution) and the equilibrium were measured. In the system UC/MnCl–NaCl for the equilibrium state, the concentrations of uranium in both solid and liquid phases are roughly equal, permitting investigation of the influence of the secondary components (small amounts of uranium oxycarbide, uranium sesquicarbide) and the impact of different alkali metal ions. The activity coefficient of uranium trichloride in these media was assessed. (13 figures, 29 references) (auth)

21880 ESCA SURFACE STUDY OF METAL BORIDES. Mavel, G. (IRCHA, Vert-Le-Petit, France); Escard, J.; Costa, P.; Castaing, J. Surface Sci.; 35: No. 1, 109-116(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

To investigate metal–boron bonding, a number of typical transition metal borides were studied using ESCA; for the sake of comparison, spectra have been obtained as well on aluminium borides as on other boron compounds. Spectra are very sensitive to surface oxidation and give a semi-quantitative appreciation of the relative oxidability of boron and metal (or metals when dealing with binary metal borides). Relevant features are discussed. (auth)

21881 (GA-5622) PRESENT STATUS OF THERMIONIC FUEL ELEMENT MATERIALS. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). 24 Aug 1964. Contract AT(04-3)-167. 26p. Dep. NTIS $3.50.

Declassified 5 Jun 1973.

The status of thermionic fuel element materials is reviewed. Information is included on fuel-cladding compatibility fuel element fabrication, radiation effects on fuel materials, and high-temperature vaporization of fuel materials. The primary fuel element materials on which research is reported include porous UC–ZrC clad with vapor-deposited W. (JRD)

21882 (HEDL-TME-73-33) MIXED-OXIDE CERAMOGRAPHY ROUND ROBIN, 1972. Treibs, H. A.; Carlson, M. C. J. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 84p. Dep. NTIS $5.45.

Photomicrographs of pellet sections prepared ceramographically by six participating laboratories from a uniform batch of mixed-oxide fuel pellets were evaluated. Results indicate that there are significant interlaboratory variations in porosity as observed from photomicrographs. Interlaboratory variations of pellet densities obtained from measurements on whole pellets were small. (auth)

21883 (HEDL-TME-73-60) ANALYTICAL EXPRESSIONS FOR ENTHALPY AND HEAT CAPACITY FOR URANIUM–PLUTONIUM OXIDE. Gibby, R. L.; Leibowitz, L.; Kerrisk, J. F.; Clifton, D. G. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 26p. Dep. NTIS $4.00.

Enthalpy data reported for UO_2–(20 to 25) wt % PuO_2 in the range from room temperature to melting were fitted to a theoretically based equation. The equation can be used to calculate enthalpy, and differentiated to obtain heat capacity in this range. The parameters of the equation are compared with corresponding theoretical values calculated for the UO_2–PuO_2 lattice. The smoothed values of enthalpy and heat capacity given by the theoretically based equations were also fitted with polynomial functions of temperature providing simpler expressions for these two properties. (auth)

21884 (JAPFNR-117) STUDIES ON SWELLING OF FAST REACTOR FUEL CAUSED BY GASEOUS FISSION PRODUCTS. II. Out-of-Pile Experiments on Eduction Behavior of Fission-Produced Gaseous Bubbles. Iwano, Y.; Tanabe, I.; Ohi, N. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa Prefecture (Japan)). Feb 1972. 30p. (PNC-J-201-72-2). Dep. NTIS (U.S. Sales Only) $3.50.

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

Irradiated UO_2 samples were annealed under high-temperature and high-pressure conditions. The eduction behavior of fission-produced gaseous bubbles in the irradiated UO_2 was observed by means of replica electron microscopy, and its resulting effect was studied in comparison with the case of an atmospheric pressure annealing. It was found that when an external pressure is applied, there is very little eduction of fission-produced gas bubbles in the crystal grains, and also that the size of gas bubbles produced in the crystal grain boundaries become smaller than in the case of atmospheric pressure annealing. As a unique phenomenon of an external pressure annealing, there was observed an eduction of fission produced gaseous bubbles in network on the crystal grain boundaries. An investigation was undertaken as to the reason for nondetection of fission-produced gaseous bubbles inside the crystal grains under high pressure. (auth)

21885 (LA-4170) TESTING OF TUNGSTEN ALLOY-URANIA CERMETS. Lenz, W. H.; Riley, R. E.; Richerson, N. K. (Los Alamos Scientific Lab., N. Mex.). 25 Apr 1969. Contract W-7405-eng-36. 24p. Dep. NTIS $3.25.

Declassified 28 Aug 1973.

A brief summary of earlier work on tungsten-base–UO_2 fuel materials is presented showing the effect of thin tungsten coats on high-temperature UO_2 loss. The presence of free uranium following high-temperature exposure in hydrogen was indicated. After sintering the cermets at 2340°C, ductility determinations suggested a stabilizing effect due to the Y_2O_3 additive. Extensive testing at 2600°C in flowing hydrogen involved W-Re and W-Mo-Re-based cermets spheroidal UO_2 fuel and tungsten-coats deposited from WF_6. The effects on test life of tungsten-coat thickness, Y_2O_3 additive, and cycling periods of 5 min, 30 min, and 4 h were determined. A comparison was made of vacuum and hydrogen atmospheres during the cycling part of the life test. Free uranium was observed in some specimens. 23 figures. (auth)

21886 (LA-5224) RESEARCH, DEVELOPMENT, AND PRODUCTION OF SUBSTOICHIOMETRIC ZIRCONIUM CARBIDE FOR HIGH-TEMPERATURE INSULATION. Wagner, P. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 31p. Dep. NTIS $4.00.

This report describes the research, development, fabrication, and evaluation of porous ZrC as an insulator for use in the high-temperature, gas-cooled Rover reactors. ZrC_x is a stable, single-phase carbide in the $0.98 \geq x \geq 0.59$ region. The thermal conductivity of ZrC_x is very sensitive to the vacancy concentration in the carbon sublattice $(1 - x)$. To decrease sufficiently the thermal-conductivity value of ZrC_x to make the insulator, the carbon-zirconium ratio was decreased to an optimum value and the thermal conductivity was decreased further by introducing porosity in the ZrC_x matrix. By these techniques, the thermal conductivity of ZrC_x at 300°K was decreased from 50 W m^{-1} K^{-1} to less than 1 W m^{-1} K^{-1}. 40 and 70% porosity ZrC_x were investigated and their properties were measured. The production material was a 70% porous fiber-based ZrC_x having satisfactory strength, thermal stress resistance, insulating power, and uniformity. (22 figures, 12 tables, 30 references) (auth)

21887 (ORNL-4883, pp 45-52) DEVELOPMENT OF THE THORIUM FUEL CYCLE. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 21, 1973.

21888 (ORNL-4883, pp 53-54) PREPARATION OF $^{233}UO_2$. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

21889 (ORNL-4883, pp 87-89) PREPARATION AND PROPERTIES OF ACTINIDE OXIDES. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

21890 EFFECT OF AN SiC ADDITION ON THE OXIDATION OF ZrB_2. Tripp, W. C. (Systems Research Labs., Inc., Dayton, OH); Davis, H. H.; Graham, H. C. Amer. Ceram. Soc. Bull.; 52: No. 8, 612-616(Aug 1973).

Gravimetric techniques and microstructural studies were combined to define the effect of an SiC addition on the oxidation behavior of zirconium diboride. Studies were carried out at 250 torr oxygen pressure in the range 800 to 1500°C. The SiC phase begins oxidizing appreciably in the range 1100 to 1300°C, resulting in the formation of an SiO_2-rich glassy layer which imparts significant improvement in the oxidation resistance of the diboride to higher temperatures. Reaction occurs at the matrix/oxide interface, with the reaction rate being controlled by diffusion through a protective scale. 8 figures. (auth)

21891 CRYSTAL STRUCTURE OF $Nb_2Zr_6O_{17}$. Galy, J. (Univ., Bordeaux); Roth, R. S. J. Solid State Chem.; 7: No. 3, 277-285(Jul 1973).

$Nb_2Zr_6O_{17}$ is orthorhombic, space group Ima2, with a = 40.91, b = 4.93, c = 5.27 Å. The asymmetric structural unit contains one octahedron, three sevenfold coordinated ions, and one square antiprism, and its relations to the fluorite and ZrO_2 structures are discussed. Variations in compositions can be accounted for by increasing or decreasing the number of sevenfold coordinated ions in the structure. (auth)

21892 STRUCTURAL EVOLUTION OF LACUNAR PEROVSKITES $Y_x(Ta_{3-3x}W_{1-2x})O_3$. Studer, F.; Montfort, Y.; Raveau, B. (Sciences-Univ., Caen, France). J. Solid State Chem.; 7: No. 3, 269-276(Jul 1973). (In French).

New nonstoichiometric perovskites $Y_x(Ta_{3-3x}W_{1-3x})O_3$ were isolated and their homogeneity ranges determined. Structural evolution as a function of composition and the atomic positions were studied. The perovskite $Y_{0.33}TaO_3$ was particularly studied; two forms were isolated: a quadratic one (high temperature) and an orthorhombic one (low temperature). The orthorhombic form observed by electron microscopy and diffraction shows nearly periodic twin bands; an hypothesis is made to explain the occurrence of these twins. (4 tables, 17 references) (auth)

21893 WORK FUNCTION OF V_2O_5(010) AND V_6O_{13}(010) SURFACES. Grymonprez, G.; Fiermans, L.; Vennik, J. (Rijksuniversiteit, Ghent). Surface Sci.; 36: No. 1, 370-372(Apr 1973).

The vibrating-capacitor method was used to establish the work function of the unperturbed V_2O_5 surface and its evolution as a function of stoichiometry and composition. The single crystals of V_2O_5 were mounted on a manipulator allowing positioning in the center of a LEED optics or in front of a coaxial-type vibrating probe, covered with a reference Au film. Systematic errors were determined using the second Au-covered stainless steel reference that could also be positioned in front of the probe. The CPD (contact potential difference) between two simultaneously deposited Au films was always smaller than 0.040 V. A change in the work function was observed upon bombardment with low-energy electrons (70 eV), giving rise to the transition into V_6O_{13}. When the bombarded surface is heated up to 400°C for 30 min, a clear V_6O_{13} LEED pattern is obtained. It is reported that the work function of the freshly cleaved V_2O_5 (010) surface is 6.712 ± 0.083 eV. The clean but perturbed V_6O_{13} surface shows a decrease in work function of ±0.7 eV as compared to V_2O_5 (010). The annealed but possibly contaminated V_6O_{13} (010) surface shows a decrease of ±0.6 eV. (MCW)

21894 SINTERING OF ZIRCONIA AS A FUNCTION OF THE STABILIZER CONCENTRATION. Rudyak, I. N.; Karaulov, A. G. (Ukrainian Scientific-Research Inst. of Refractories, Kharkov). Refractories (USSR) (Engl. Transl.); 13: No. 9-10, 663-666(1972).

Translated from Ogneupory; 13: No. 10, 41-44(Oct 1972).

The kinetics and the features of sintering and strengthening of ZrO_2 with additions of 4 and 6 wt.% CaO were studied. With the increase from 4 to 6 wt.%, there is an acceleration in the transfer of matter, connected with an increase in the defects in the crystal lattice and reinforcement of the diffusion processes, and a more rapid grain growth and an increase in the strength of the material with temperature were also observed, but this retards the process of densification. It is confirmed that the shrinkage kinetics of mixtures of ZrO_2 and CaO independent of the degree of stabilization of the zirconium dioxide, are proportional to $\tau^{1/3}$ in the period of removal of open pores and $\tau^{1/2}$ in the subsequent period involving removal of the closed pores. (auth)

21895 SINTERING AND RECRYSTALLIZATION OF YTTRIUM OXIDE. Borovkova, L. B.; Lukin, E. S.; Poluboyarinov, D. N. (Inst. of Chemical Tech., Moscow). Refractories (USSR) (Engl. Transl.); 13: No. 9-10, 595-600(1972).

Translated from Ogneupory; 13: No. 9, 47-53(Sep 1972).

The sintering of pure yttrium oxide was studied in the range 1800 to 2100°C with a soak of up to 30 h. The kinetics of densification and grain growth were studied during sintering, and the corresponding activation energy levels were calculated. The influence of additional high-temperature processing on the change in properties and structure of Y_2O_3 ceramics was studied. It is shown that yttrium oxide ceramics (relative density about 97% of the theoretical) after processing in vacuum for a period of 10 to 100 h at 1900 to 2100°C possess a stable density and dimensions, slight grain growth, and loss in weight. (auth)

21896 ELECTRON MICROSCOPY OF β HYDRIDE IN NIOBIUM. Schober, T.; Pick, M. A.; Wenzl, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 18: No. 1, 175-182 (16 Jul 1973).

Electron microscopy of the β-hydride phase of Nb showed domain boundaries with δ-fringes arising from the ordering of hydrogen. A diffraction analysis carried out on a single domain resulted in a reciprocal lattice which is identical with that one deduced from neutron diffraction experiments. The β-hydride structure in Nb belongs to the orthorhombic space group P_{nnn} with Nb atoms on f(000, 0 ½ ½, ½ 0 ½, ½ ½ 0) and H on a(¼ ¼ ¼, ¾ ¾ ¾) and b(¾ ¼ ¼, ¼ ¾ ¾). (7 figures) (auth)

21897 X-RAY DETERMINATION OF DEBYE TEMPERATURE OF TANTALUM CARBIDE. Sirdeshmukh, D. B.; Rao, M. J. M. (Government Coll. of Science and Arts, Khammam, India). Phys. Status Solidi (a); 17: No. 2, K169-K172(16 Jun 1973).

The Debye temperature of $TaC_{0.995}$ was determined by x-ray diffraction, with corrections being made for thermal diffuse scattering. The result, $\theta = 393 \pm 12°K$, is compared with literature values. (DLC)

21898 THERMAL AND LOW-ENERGY ELECTRON-BOMBARDMENT-INDUCED OXYGEN LOSS OF V_2O_5 SINGLE CRYSTALS: TRANSITION INTO V_6O_{13}. Colpaert, M. N.; Clauws, P.; Fiermans, L.; Vennik, J. (Rijksuniversiteit, Ghent). Surface Sci.; 36: No. 2, 513-525(May 1973).

Thermal treatment in uhv of clean V_2O_5 single crystals results in homogeneous oxygen loss, involving a rate-limiting surface reaction. Depending upon the pretreatment, air-cleaved samples transform topotactically into V_6O_{13}, or into what we call a phase Q of probable composition V_4O_9 or $V_6O_{13.5}$. Low-energy electron bombardment of clean uhv-cleaved V_2O_5(010) surfaces produces the transition $V_2O_5 \rightarrow V_6O_{13}$ at room temperature. This effect is attributed to electron-beam-stimulated reactions. The influence on the transition of carbon-containing impurities is discussed. The nucleation of V_6O_{13} on V_2O_5 is explained by a model based on a surface reaction, the rate of which is enhanced by the interaction with contaminating molecules and low-energy electron bombardment. The presence of shear planes at the boundary between V_2O_5 and the V_6O_{13} nuclei locally enhances the oxygen loss rate and allows the V_6O_{13} nuclei to grow into the bulk. The enhanced mobility of the oxygen at these boundaries is thought to influence favorably the oxidation-regeneration rate of the V_2O_5 catalyst. (auth)

21899 EVIDENCE OF DISLOCATION DISSOCIATION IN NEARLY STOICHIOMETRIC TANTALUM CARBIDE USING THE WEAK-BEAM TECHNIQUE. Martin, J. L. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France). J. Microscopy; 98: No. 2, 209-213(Jul 1973).

From EMCON symposium on applications of the weak beam technique in materials science; Manchester, England (12 Sep 1972).

The dissociation of dislocations in nearly stoichiometric tantalum carbide was revealed by the weak-beam technique; this is in agreement with the assumptions of a model of dislocation glide that was derived for this compound. An order of magnitude of the partial spacing for the screw and the edge dislocation is 2.7 and 5.2 nm, respectively, which leads to a stacking-fault energy of about 170 mJ m^{-2} (erg cm^{-2}). (auth)

21900 DISLOCATION NETWORKS IN TUNGSTEN CARBIDE STUDIED BY THE WEAK-BEAM TECHNIQUE. Johannesson, T.; Lehtinen, B. (Coromant Research Center, Stockholm). J. Microscopy; 98: No. 2, 226-228(Jul 1973).

From EMCON symposium on applications of the weak beam technique in materials science; Manchester, England (12 Sep 1972).

Dislocation networks in tungsten carbide (WC) were studied in the HVEM. The nodes of the network were resolved by using the weak-beam technique in the high-voltage electron microscope. They consist of parallel partial dislocations, which are concluded to have Burgers vectors of the type b = ⅙ (20$\bar{2}$3). (auth)

21901 VIBRONIC PROPERTIES OF THE F^+CENTRE IN STRONTIUM OXIDE. Hughes, A. E.; Webb, A. P. (Atomic Energy Research Establishment, Harwell, Eng.). Solid State Commun.; 13: No. 2, 167-169(15 Jul 1973).

The shape and moments of the F^+ absorption band in irradiated SrO were measured between 4.2 and 300°K. Analysis of the moments gives the effective frequency of the vibrational modes interacting with the center as $h\omega = 236 \pm 20$ cm^{-1}, and the Huang–Rhys factors for cubic and noncubic modes as $S_C = 3 \pm 1$ and $S_{NC} = 4 \pm 1$, respectively. (auth)

21902 TECHNOLOGY AND PROPERTIES OF CERANOX MATERIALS. Nitzsche, H. G.; Fickel, A. F. (Annawerk GmbH, Roedental-Oeslau, Ger.). Haus Tech., Essen, Vertragsveroeff.; No. 287, 16-22(1972).

A review is given on the nonoxide ceramic materials such as carbides, nitrides, borides, and silicides. These so-called ceramic materials have been applied in new fields of chemical technology during the last few years, some have become of great significance in nuclear technology. A report is given on the various methods of preparation, fields of application, and on the chemical behavior of ceranox materials. (GE)

21903 STANDARD FREE ENERGIES FOR THE FORMATION OF $UFeC_2$ AND UWC_2 BY ELECTROMOTIVE FORCE MEASUREMENTS. Tanaka, H.; Kishida, Y.; Moriyama, J. (Kyoto Univ.). J. Jap. Inst. Metals; 37: No. 5, 564-567(May 1973). (In Japanese).

The standard free energies for the formation of $UFeC_2$ and UWC_2 were determined by emf measurements. The following fluorine concentration cells were operated in the temperature range 700 to 820°C: W/U, UF_3/CaF_2 (single crystal)/UF_3, $UFeC_2$–Fe–C/W; and W/U, UF_3/CaF_2 (single crystal)/UF_3, UWC_2–WC–W/W. From the emf values and temperature dependences, the standard free energies of formation of the above carbides were calculated and results are given. (auth)

21904 TECHNOLOGICAL CONDITIONS FOR PRODUCTION OF TITANIUM AND NIOBIUM NITRIDES BY REDUCTION OF THE OXIDES WITH CARBON AND SIMULTANEOUS NITRIDING. Samsonov, G. V.; Polishchuk, V. S. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 2, 257-262(Feb 1973).

Translated from Zh. Prikl. Khim.; 46: No. 2, 242-246(1973).

The rate of reduction and nitriding of titanium and niobium is influenced significantly by diffusion phenomena in transport of gaseous carbon monoxide and nitrogen in the pores of the compacted reaction mixture; the degree of this influence on the overall reaction rate depends on the pore radii and on the geometrical dimensions of the briquets, especially at the initial stage of the

reaction. On the basis of the results of this investigation the technological conditions were determined for production of titanium and niobium nitrides by reduction of their oxides with carbon and simultaneous nitriding, ensuring minimal contamination of the reaction products with carbon. (auth)

21905 HIGH TEMPERATURE COMBUSTION CALORIMETRY. II. Enthalpies of Formation of Vanadium Oxides. Charlu, T. V.; Kleppa, O. J. (Univ. of Chicago). High Temp. Sci.; 5: No. 4, 260-268(Aug 1973).

The enthalpies of formation of V_2O_3, V_3O_5, V_2O_4, V_6O_{13}, and of the Magneli phases V_nO_{2n-1} (n = 4 to 8) were determined by oxidation to V_2O_5 (s) in a high-temperature microcalorimeter. The data are compared with those available in the literature. Results indicate that phases V_nO_{2n-1} with n > 8 are not thermodynamically stable with respect to decomposition to V_2O_3 and V_2O_4. (auth)

21906 VAPORIZATION BEHAVIOR OF THE DEFECT CARBIDES. III. The Vanadium–Carbon System. Storms, E. K.; Lowe, A.; Baca, E.; Griffin, J. (Los Alamos Scientific Lab., NM). High Temp. Sci.; 5: No. 4, 276-290(Aug 1973).

The vanadium activity and the partial molar enthalpy of vaporization were determined in the V–C system as a function of temperature between 1600 and 2200°K and as a function of composition between $VC_{0.47}$ and $VC_{1.2}$ (total carbon) using a mass spectrometer. Similar thermodynamic quantities were obtained for carbon from a Gibbs–Duhem integration and these values were combined with those for vanadium to give the entropy and enthalpy of formation and the total vaporization energy. The following conclusions apply to nominal $VC_{0.9}$: (a) The entropy of formation is near zero at 1900°K rather than –2.6 cal/mole-deg as indicated by the published thermal functions. (b) A heat of formation at 298°K of –25.0 ± 0.4 kcal/mole was calculated. (c) The upper phase boundary of VC is $VC_{0.91}$ at 1700°K. At 1403°K, the structure orders to give V_8C_7 and free carbon. The data were combined with an evaluation of the literature to give a more complete phase diagram for the system. VC_2(g) was studied and found to have a heat of formation from C(s) and V(g) of 62 ± 2 kcal/mole at 0°K. (7 figures, 9 tables, 37 references) (auth)

21907 VAPORIZATION BEHAVIOR OF THE DEFECT CARBIDES. IV. The Zirconium–Carbon System. Storm, E. K.; Griffin, J. (Los Alamos Scientific Lab., NM). High Temp. Sci.; 5: No. 4, 291-310(Aug 1973).

The zirconium activity in ZrC was measured as a function of composition between $ZrC_{0.58}$ and ZrC + C and as a function of temperature between 1700 and 2200°K using a high-temperature mass spectrometer. In addition, the partial molar enthalpy of vaporization for zirconium was obtained. The effects of an oxygen impurity on the activity and partial enthalpy of zirconium as well as the lattice parameter of $ZrC_{0.645}$ were determined. This information was used to calculate the high-temperature total and partial free energies as a function of composition, the congruently vaporizing composition, and to determine the phase boundaries of the ZrC phase. A bonding model is discussed to explain the behavior of this as well as the other transition metal carbides. (9 figures, 7 tables, 37 references) (auth)

21908 FORMATION OF URANIUM NITRIDE BY THE REACTION OF URANIUM HYDRIDE WITH NITROGEN AND AMMONIA. Tagawa, H. (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 46: No. 4, 1158-1161(Apr 1973).

The hydrogenation of uranium metal and the nitrogenation of uranium and its hydride with either nitrogen or ammonia were studied using thermogravimetry. The reactions were examined at different pressures of hydrogen, nitrogen, and ammonia. The reaction of uranium with hydrogen takes place at 200°C and proceeds quickly above 210°C. The conversion curve depends greatly on the hydrogen pressure. In the reaction of the hydride with nitrogen, the weight gain occurs at about 160°C and becomes fast above 240°C. The reaction is shown to proceed in two steps: the formation of the mononitride and that of the sesquinitride. The reaction between uranium hydride and ammonia begins at 150°C and becomes rapid above 300°C. The reaction proceeds monotonously, and no step is observed. The nitrogenation behavior of uranium hydride with ammonia is found to be quite different from that in reaction with nitrogen. (auth)

21909 RARE-EARTH MIXED DICARBIDES. Adachi, G. Y.; Nishihata, T.; Shiokawa, J. (Osaka Univ.). J. Less Common Metals; 32: No. 2, 301-306(Aug 1973).

Solid solutions of two different rare-earth carbides were prepared, and the relation between their lattice constants and compositions is discussed. Body-centered tetragonal solid solutions were formed in the whole range of LaC_2–(Ce ~ Tb)C_2, CeC_2–(Pr ~ Ho,Y)C_2 and PrC_2–(Nd ~ Tm)C_2. Vegard's law was upheld in these bct solid solutions because the difference in ionic radius of the rare-earth metals is not very large. On the other hand, new fcc phases were found in the systems LaC_2–(Dy ~ Tm)C_2, CeC_2–(Er,Lu)C_2 and PrC_2–LuC_2. In addition, a hexagonal modification was obtained in the LaC_2–LuC_2 system. (auth)

21910 NEW HIGH-STRENGTH ALUMINUM NITRIDE. Komeya, K.; Kubo, T.; Tsuge, A.; Inoue, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 28: No. 6, 656-660(Jun 1973). (In Japanese).

A new type of sufficiently densified and very strong aluminum nitride (AlN) with controlled fibrous texture was formed by sintering or hot pressing of AlN compacts containing a small amount of yttrium oxide (Y_2O_3) and silica (SiO_2). In the sintering, the Y_2O_3 and SiO_2 promote densification and fibrous structure formation, respectively. This new AlN ceramics, being superior to conventional AlN in mechanical strength, thermal shock resistance, corrosion resistance, and electrical resistance, will be very useful for various purposes, such as crucibles and jigs for molten metals, gas turbine parts, radiators, hot pressing molds, and electric insulators. (auth)

21911 DETERMINATION OF THE CONGRUENT MELTING POINT OF ZIRCONIUM NITRIDE. Eron'yan, M. A.; Avarbe, R. G.; Nikol'skaya, T. A. (Inst. of Applied Chemistry, Moscow). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 2, 440(Feb 1973).

Translated from Zh. Prikl, Khim.; 46: No. 2, 428(Feb 1973).

The mp of Zr nitride under 1 atm N_2 was determined to be 3040 ± 70° under nonequilibrium conditions. Under thermal equilibrium and N_2 pressures >60 atm, the nitride melts congruently at 3700 ± 70°; its composition is $ZrN_{0.98}O_{0.01}$. (DLC)

21912 OPTICAL PROPERTIES OF ION BOMBARDED SILICIA GLASS. Bayly, A. R. (Univ. of Sussex, Eng.). Radiat. Eff.; 18: No. 1-2, 111-118(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Refractive index profiles, produced by ion irradiation in silica glass, have been measured, using ellipsometry, by sectioning the implanted region, obtaining a series of measurements at progressively deeper levels and analyzing the profile as a stack of thin homogeneous layers. Results have been obtained for He^+, Ar^+ and Kr^+ implantations using hydrofluoric etching as the sectioning technique. It was found that the profile consists essentially of a shallow peak near the surface of 1.0 → 1.5% change in index, and a deeper peak which seems to saturate at a change of ~1.0%. The deep peak shows good agreement with theoretical damage distributions for low dose He^+ but shows signs of saturation after a dose of $5 \times (10)^{15}/cm^2$ 20-kV He^+. For Ar^+ and more so for Kr^+ at doses of $1 \times (10)^{16}$ ions/cm^2 at 300 kV there appears significant broadening of the profiles compared to theory. Although this might be explained by damage saturation, the lack of any obvious implantation effect suggests a possible explanation in terms of a redistribution of the implanted species by the compaction effect which occurs in silica. Alternatively, the implanted species may oppose compaction. Backscattering studies are proposed to resolve these questions. (auth)

Metals and Alloys

Refer also to abstracts 23898, 23930, 23974, 23991, 23997, 24015, 24016, and 24034.

21913 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate Zeitschrift. Band 7, Heft 1-3. 1. Vierteljahresregister 1973. (Plutonium Documentation. Transplutonium Elements. Abstract Journal. Vol. 7, No. 1-3, 1973. 1st Quarter Index). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1973). 64p. (In German and English).

The indexes include author, report number, and patent number. Listings are also given of review articles, progress reports, books, and conferences. (DLC)

21914 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate Zeitschrift. Mai 1973. Band 7, Heft 5. 244 Referate (Register-1796-2216); 67 Referate (Register-Nr. 323T-389T)). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. May 1973. Vol. 7, No. 5. 244 Abstracts (Register No. 1796-2216); 67 Abstracts (Register No. 323T-389T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (Apr 1973). 134p. (In German and English).

21915 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Juni 1973. Band 7, Heft 6. 212 Referate (Register Nr. 2217-2692); 80 Referate (Register-Nr. 390T-469T)). (Plutonium-Documentation. Transplutonium elements. June 1973. Vol. 7, No. 6. 212 Abstracts (Register No. 2217-2692); 80 Abstracts (Register No. 390T-469T)). Karlsruhe, Ger.; Gesell-

schaft fuer Kernforschung m.b.H. (1973). 146p. (In German and English).

21916 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate Zeitschrift. April 1973. Band 7, Heft 4. 182 Referate (Register-Nr. 1403-1795); 78 Referate (Register-Nr. 245T-322T). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. April 1973. Vol. 7, No. 4. 182 Abstracts (Register No. 1403-1795); 78 Abstracts (Register No. 245T-322T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (Apr 1973). 125p. (In German and English).

Corrosion and Erosion

Refer also to abstract 20739.

21917 (AD-758097) BASIC MECHANISMS PROVIDING OXIDATION RESISTANCE IN STRUCTURAL METALS AT HIGH TEMPERATURES. Final Report, 20 February–20 December 1972. Rosa, C. J. (Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering). Feb 1973. Contract N00019-72-C-0186. 47p. NTIS.

The purpose of the study was research of a fundamental nature in order to gain knowledge about high-temperature oxidation behavior of structural, titanium-base alloys operating above 900°C. Oxidation characteristics of Ti–4.32 wt % Nb and Ti–4.37 wt % Ta alloys are reported for the temperature range 1000 to 1200°C. The influence of oxygen pressure of 10, 100, and 760 torr on the oxidation kinetics of Ti–4.37 wt % Ta, as well as sintering effects in the oxide are also investigated. The oxidation behavior of Ti–4.32 wt % Nb in dry oxygen and air at 1000 and 1100°C is reported. (auth)

21918 (AEC-tr-7458) INFLUENCE OF THE GRAIN SIZE AND OXYGEN CONTENT ON THE OXIDATION KINETICS OF ZIRCONIUM. Com-Nougue, J.; Ono, K.; De Gelas, B.; Beranger, G.; Lacombe, P. Translated from J. Less-Common Metals; 19: 259-272(1969). 17p. Dep. NTIS $3.00.

The influence of two important factors, i.e., the grain size and the oxygen content of α-Zr, on the oxidation kinetics is studied and discussed. Large α-Zr grain size samples (mean grain size 5 mm) were obtained by thermally cycling in vacuum through the $\alpha \rightleftharpoons \beta$ phase transformation. At temperatures <650°C, the larger the grain size the slower the rate of oxidation. This result can be explained by a grain-boundary diffusion mechanism at the lower temperatures. Zirconium–oxygen alloys were prepared by oxidation of pure zirconium samples followed by a high-vacuum anneal at 1050°C. The homogeneity and final oxygen concentrations were strictly verified and determined. The oxidation kinetics were studied at different temperatures and it clearly appears that the oxidation rate markedly increases with increase of initial oxygen content. In addition, some structural observations in relation to the oxidation temperature are made. (9 figures, 24 references) (auth)

21919 (GEAP-10394) EFFECTS OF SODIUM EXPOSURE ON THE CORROSION AND STRENGTH OF STAINLESS STEELS. Summary Report: Sodium Mass Transfer Program. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). Aug 1971. Contract AT(04-3)-189. 117p. Dep. NTIS $8.00.

Results are presented on investigations of the effects of high-temperature (to 1300°F) flowing sodium on five stainless-steel-alloy candidates for use as structural materials of LMFBR primary coolant systems. Precision of control and measurement of parameters such as oxygen concentration and temperature were substantially improved relative to prior work. Corrosion rate for Type-316 stainless steel at 1300°F is 0.84 ± 0.3 mil/y (3 ± 2 ppM oxygen > 20 ft/s, and essentially zero downstream). Mechanical properties important to cladding design were significantly degraded by exposure to typical central-core sodium conditions. The degradation was found to be caused by both changes in chemical composition and mass transfer. On long exposure, several effects of sodium were found, including removal of minor elements such as carbon, nitrogen, and boron; formation of sigma phase; and formation of subsurface voids. These effects combine to produce time- and temperature-dependent limits on the retention of any given level of design properties. Typical times for significant reduction in useful properties range from about 3,000 hours at 1300°F to more than 10,000 hours at 1200°F. Another significant byproduct of the mass-transfer process is the transport of radioactivity within the primary system. The desirability of providing the capability for remote handling and maintenance of LMFBR primary-system components was indicated in a test that measured ^{60}Co transfer, quantitatively, from the high-temperature zone (1300°F) of a test loop to zones corresponding to IHX, pump, and piping regions. In another series of tests, particulate materials were observed, both as surface deposits (by scanning electron microscope) and as particles filtered from sodium streams. The limited data indicate that particle deposition may be significant to system design and operation under extreme conditions through fouling of IHX, surfaces, potential blockage of small diameter flow passages, as well as its contribution to radioactivity buildup in components. The question of use of small-loop data for large subsystems was approached by calculation of effective boundary-layer thicknesses as a function of duct size and flow velocity. To the limited extent of this work, it appears feasible to duplicate the full range of the hydrodynamic conditions important to mass transfer in large system designs using only small test loops. During this phase of the program, typical oxygen levels in sodium were maintained at about 3 ppM (extreme range 1 to 4 ppM). Cold traps were controlled to ± 2°F. The efficiency of standard cold traps was improved from 50% to 99% by increasing crystallizer turbulence without increasing net mass flow. This improvement will allow reductions of size and cost of cold traps for large LMFBR systems. Impurities in sodium were monitored by a combination of on-line distillation, oxygen meters, plugging meters, and chemical analysis of samples. Amalgamation analysis was made more specific for sodium oxide by an improved method which corrected for hydride and carbonate. Precision of analysis was enhanced by improving the procedure and reproducibility of the blank correction. (A proposed revised standard has been prepared and circulated.) (auth)

21920 (ORNL-tr-2539) CORROSION RESISTANCE OF METALLIC MATERIALS IN NITROGEN OXIDES AT HIGH TEMPERATURES AND PRESSURES. I. Sukhotin, A. M.; Lantratova, N. Ya.; Gerasimova, V. A. Translated from Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 2, 28-34(1968). 10p. Dep. NTIS $3.00.

The corrosion resistance of stainless steels and alloys of nickel, grey pig-iron, aluminum and aluminum alloys, titanium, and titanium alloys in the stoichiometric mixture of nitrogen oxides N_2O_4 $N_2O_4 \rightleftharpoons 2NO_2 \rightleftharpoons 2NO + O_2$ in dependence on temperature and pressure was investigated. The influence of moisture presence in oxides on the corrosion resistance of materials, and also the change of mechanical properties of steels after investigations was studied here as well. (auth)

21921 (WAPD-TM-1049) CORROSION PROPERTIES OF NiCrFe ALLOY 718 AND NICROBRAZ-50 (BNi-7) (LWBR DEVELOPMENT PROGRAM). Mizia, W. A. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Jun 1973. Contract AT-11-1-GEN-14. 54p. Dep. NTIS 14.75.

Experimental data are presented on the out-of-pile corrosion properties of NiCrFe alloy 718 sheet, bar, and wire material, and Nicrobraz-50 (BNi-7) braze alloy in slurry, paste, and tape form. This program was undertaken in support of the Light Water Breeder Reactor development program. The testing procedures and significance of the data generated are discussed. Testing variables included environment, material form, and stress level. It was observed that NiCrFe alloy 718, subject to a braze-heat treatment, is susceptible to intergranular stress corrosion cracking in several environments including primary water. Nicrobraz-50 braze alloy exhibited good corrosion resistance in the environments investigated. (6 tables, 18 figures) (auth)

21922 COMPARATIVE BEHAVIOR OF COPPER ALLOYS, NAMELY TIN BRONZES AND BRASSES, WHEN ALLOYED WITH VARIABLE PROPORTIONS OF BERYLLIUM. Garrigo, F.; Roig, J. ATF Colada; 3: No. 12, 710-715(Dec 1970). (In Spanish).

Beryllium additions of 0.40 to 1.70% were made in melts of 90–10 Sn bronze and 60–40 brass. The microstructure of slowly cooled Sn bronzes varied with Be content, the chief effect being on the amount of the β phase formed. The influence of Be on the rate of diffusion of Sn was much less in the case of rapid cooling, the role of Be being limited to its effect on grain size. Beryllium had no effect on the proportions of the α and β phases in the brasses. The Brinell hardness, tensile strength and elongation improved in all of the alloys in the as-cast condition in direct proportion to Be content. Specific conductivity was affected only slightly by the additions. Beryllium improved the corrosion resistance of Sn bronzes in distilled H_2O and in H_2SO_4, HCl, NaCl, and NaOH solutions, except in the cases of alloys containing 0.40 and 0.81% Be in salt water. The brasses containing Be showed no improvement in this respect except in a solution of NaOH. The high-temperature oxidation resistance of all the alloys in 24-h tests at 400°C was appreciably increased by the Be additions. (Metals Abstr.)

21923 CORROSION OF INCOLOY 800 AND NICKEL-BASE ALLOY WELDMENTS IN STEAM. Hammond, J. P.; Patriarca, P.; Slaughter, G. M.; Maxwell, W. A. (Oak Ridge National Lab., TN). Weld. J. (N. Y.); 20: No. 6, vp. (Jun 1973).

The corrosion characteristics of similar and dissimilar metal weldments in Incoloy 800 and various nickel-base alloys for use in advanced gas-cooled nuclear steam generators were tested in isothermal exposures in dynamic steam at 595 and 650°C at 900 psi pressure for periods to 16,000 h (2 years). Cursory examinations were made on some weldment specimens after exposure to 27,000 h. Twelve alloy combinations, in which base metals having good high-temperature properties (Inconel 625, Hastelloy X, and IN 102) were joined to Incoloy 800 (a material having attractive intermediate temperature properties) and to themselves, were examined in the surface ground condition. Three high-temperature alloys and Inconel 82 were employed as filler metals. To assess the effects of surface condition, the dissimilar metal weldments and nonwelded specimens in the various base metals were also tested after being electropolished to eliminate worked surfaces. General corrosion was determined by weight gain, weight loss, and scale thickness measurements, and preferential attack in fusion line areas was assessed by metallographic means. Projected long time corrosion amounts were very small (<11 mg/cm^2 in 20 years) for all the weldments tested except those in Inconel 600, and for this weldment the projected corrosion was only 43 mg/cm^2 after 20 years. No evidence of aggravated attack at fusion line areas was disclosed. These findings appear to be applicable to lower temperatures. 17 figures, 7 tables. (auth)

21924 HYDROGEN-PROMOTED CORROSION OF TUNGSTEN BY OXYGEN IN AN ELECTRIC FIELD: A FIELD ION MICROSCOPE STUDY. Cranstoun, G. K. L.; Anderson, J. A. (Oxford Univ.). Surface Sci.; 35: No. 1, 319-335(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

The extensive changes in surface topography observed to occur on tungsten field ion emitters as a result of exposure to oxygen in presence of hydrogen at 78°K and at fields of 2 V/Å have been studied in detail. Field-promoted diffusion of gas from the low field region of the emitter shank over the imaged area of the surface removes kink-site metal atoms and subsequently deposits them on either side of the well-defined diffusion paths along close-packed zones; field evaporation of such atoms may also occur when the change in local surface contour causes sufficient field enhancement. Although oxygen is primarily responsible for the corrosion effects, its diffusion at such temperatures is promoted by the presence of hydrogen, and the rate of reaction is independent, inter alia, on hydrogen pressure. (auth)

21925 PSEUDOMORPHISM IN ULTRA-THIN METAL FILMS. Smith, G. D. (Oxford Univ.). Surface Sci.; 35: No. 1, 304-318 (Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

Current models of the processes preceding nucleation and epitaxial growth of metal thin films on metallic substrates are reviewed briefly, with particular reference to field emission and field ion microscope studies of metallic adsorbates on tungsten. It is concluded that many aspects of the phenomena of pseudomorphism, and of crystal nucleation at high adsorbate coverages, can be understood in terms of the structural features of the substrate surface and the strength of the adsorbate–substrate interaction. (45 references) (auth)

21926 COADSORPTION OF OXYGEN AND CARBON MONOXIDE ON TUNGSTEN: DESORPTION SPECTRA, ELECTRON STIMULATED DESORPTION, AND FIELD EMISSION MICROSCOPY. Goymour, C. G.; King, D. A. (Univ. of East Anglia, Norwich, Eng.). Surface Sci.; 35: No. 1, 246-270(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

CO/W desorption spectra are characterized by an α state and multiple β states; using electron stimulated desorption (ESD) the α state was shown to comprise two sub-states, α_1 and α_2. The consecutive interactions of O_2 and CO on W are investigated using ESD, flash desorption, and field emission microscopy (FEM). Desorption spectra show that the α-CO state is displaced by O_2, in two stages. The ESD probe provides an identification of the first stage with the removal of the α_1-CO state, and energy analysis of ESD ions reveals a large energy shift (~–1.5 eV) during O_2 coadsorption, which can be attributed to an increase in the α_1-CO W–C bond length of ~0.15 Å. During this O_2-induced displacement, the two β peaks converge into a single peak at the β_1 position; this is ascribed to adatom interactions in the mixed O and C adlayer. Isotope exchange experiments with ^{28}CO and $^{36}O_2$ reveal (i) no exchange in the α-CO states, and (ii) complete exchange in the β-CO states, which is consistent with dissociative adsorption in the latter. The amount of coadsorbed O_2 is estimated from these results, and from FEM data: a full monolayer of O adatoms can be coadsorbed on CO-saturated W, but CO preadsorption inhibits the formation of W oxides. The β_1-O_2 (ESD active) state also forms on the CO-covered surface: this state is identical in population, ESD cross section and ion energy distribution to β_1-O_2 on clean W, and retains its identity in the mixed layer (it does not undergo isotopic exchange). CO_2 desorption spectra from the mixed layer were also characterized, complete isotopic scrambling being observed. Pre-exposure of tungsten to O_2 inhibits CO adsorption: a monolayer of O_2 is sufficient to prevent CO adsorption, and at low O_2 coverages, every O_2 molecule preadsorbed prevents one CO molecule from adsorbing. Isotopic exchange is again complete in the β states, and a lateral interaction model for desorption kinetics, based on dissociative adsorption in the β-CO state, quantitatively describes the CO desorption spectra. (24 references). (auth)

21927 QUANTITATIVE ASPECTS OF AUGER ELECTRON SPECTROSCOPY; ON THE IMPORTANCE OF ATTENUATION OF THE PRIMARY ELECTRON BEAM. Vrakking, J. J.; Meyer, F. (Philips Research Labs., Eindhoven, Netherlands). Surface Sci.; 35: No. 1, 34-41(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

Measurements of Auger electron currents at different energies of the primary electrons and at different angles of incidence suggest that attenuation of the primary electron beam in the crystal has a significant influence on the measured Auger currents. This makes it possible to distinguish between a monolayer and a multilayer system, i.e., between impurity atoms in the top atomic layer and impurity atoms dispersed through the surface region. Comparison of AES and ellipsometric measurements of monolayer and multilayer systems on silicon and germanium surfaces shows that AES results can be interpreted to give quantitative information about the number of atoms of the type investigated. (auth)

21928 CHARGE STATES OF 25- TO 150-keV H AND ^{4}He BACKSCATTERED FROM SOLID SURFACES. Buck, T. M.; Wheatley, G. H.; Feldman, L. C. (Bell Telephone Labs., Inc., Murray Hill, NJ). Surface Sci.; 35: No. 1, 345-361(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

Measurements were made of the ion fractions of H and ^{4}He backscattered with energies of 25 to 160 keV from Cu, Au, and Si surfaces etched and washed but not atomically clean. The ion fractions for H range from 0.37 at 25 keV to 0.92 at 160 keV, and for ^{4}He from 0.10 at 30 keV to 0.58 at 150 keV, depending to a small extent on the target material. Where comparisons can be made the data agree rather closely with results of others for particles traversing thin foils. The data are useful for calibration of an electrostatic analyzer in surface analysis. Plots of ion fraction against particle velocity show a primary dependence on velocity, as expected, but there is a small difference in slope between the H and He curves. Charge states of particles scattered from surface impurities did not deviate significantly from those of particles scattered from the substrate at the same energy. (30 references) (auth)

21929 RUTHERFORD SCATTERING STUDY OF DIFFUSION OF HEAVY METAL IMPURITIES IN SILICON TO ION-DAMAGED SURFACE LAYERS. Buck, T. M. (Bell Telephone Labs., Inc., Murray Hill, NJ); Poate, J. M.; Pickar, K. A.; Hsieh, C. M. Surface Sci.; 35: No. 1, 362-379(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

Rutherford backscattering of 1.75 and 2 MeV $^4He^+$ ions was utilized to study the high-temperature gettering of Fe, Co, Ni, Cu, and Au from silicon by ion-damaged surface layers. In a typical experiment a metal film was evaporated onto one side of a silicon wafer (125 μm thick) that had received ion implantation damage (10^{16}/cm^2 Si^+ ions at 100 keV) on the opposite side; the wafer was then annealed at 900°C, usually for 30 min. The results of such experiments show that the metals studied may be divided into two classes, those which are gettered slowly—Fe, Co, and Au, and those gettered rapidly—Cu and Ni. Fe, Co, and Au were found at levels of 1×10^{13} to 1×10^{14}/cm^2 in the damaged layer, whereas Cu and Ni appeared at levels of 6×10^{14} to 5×10^{16}/cm^2. The gettered level of Au, one of the "slow" group, was increased ten-fold by an equal increase in the anneal time to 300 min. The gettered Cu and Au exhibited double peaks in the scattered ion spectra, corresponding to metal concentrated at the most heavily damaged region (end of range for Si implant) and also at the outer surface, with a separation of ~1300 Å. A simple model is proposed to explain the slow and fast gettering, based on published interstitial diffusivities and solubilities of the five elements studied. Rutherford scattering has proven to be well suited for the quantitative identification of low levels of impurities on Si surfaces and for impurities gettered at damaged layers close to the surface. (37 references) (auth)

21930 INELASTIC EFFECTS AND STRUCTURE IN AUGER ELECTRON EMISSION SPECTRA OF V_2O_5(010) AND V(100) SURFACES: STUDY OF CHEMICAL SHIFTS. Fiermans, L.; Vennik, J. (Rijksuniversiteit, Ghent). Surface Sci.; 35: No. 1, 41-62(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

Characteristic ionization losses and plasma losses occurring in the AES spectra of V_2O_5 (010) and V(100) surfaces are discussed. The former are used to evaluate chemical shifts of the VL_2 and VL_3 levels in V_2O_5. Values of approximately 2.5 eV are found. These are smaller than the values obtained with ESCA (±5 eV). It is described how the electron beam used in AES is thought to be responsible for this effect. ESCA data from partly reduced V_2O_5 samples tend to confirm the proposed model, based on oxygen loss and decomposition of V_2O_5 single crystals under the influence of the electron beam. The plasma losses of the larger Auger peaks are discussed. It is shown how some fine structure in the spectra can be partly explained by their presence. The plasma losses were simulated with numerical techniques based on the use of a signal averager. Signal averaging, curve fitting, and related numerical techniques improve the resolution of AES spectra. Spectra of V_2O_5 (010) and V (100) obtained in this manner are discussed. With respect to the transitions involving the valence band it is shown that the complex valence band structure is one of the causes of the observed discrepancies between theoretical and experimental AES data. Furthermore there is an uncertainty concerning the way in which ionization correction should be applied in this case. This correction is thought to increase with the degree of localization of the valence electrons. Auger peak intensities in function of the primary energy were found to show a maximum at about 3.5 times the critical potential, as was expected from theory if a moderate amount of backscattering is taken into account. Finally the intensity variations of the Auger peaks under continuous electron bombardment show the rate of oxygen loss at a V_2O_5 surface due to the primary beam. (29 references) (auth)

21931 CHANGE OF CONDUCTIVITY OF ERBIUM FILMS CAUSED BY SORPTION OF HYDROGEN AND OXYGEN. Singh, B.; Surplice, N. A. (Univ. of Keele, Eng.). Surface Sci.; 35: No. 1, 493-495(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

Films of erbium were evaporated onto the inside wall of a pyrex glass reaction vessel at 10^{-9} torr. Their mean thickness (200 to 600 Å) was deduced from their mass and geometrical area. Estimates of their surface areas were made from the physical adsorption of krypton at 78°K (BET method) giving a mean specific surface area of 71 $m^2\ g^{-1}$. The number of surface sites was calculated from a relationship given by Brennan et al. (1960). The sorption of hydrogen and oxygen was studied separately, by measuring the changes in the electrical resistance of the films as a function of the amount of pure gas admitted to the reaction vessel in measured doses $\sim 10^{18}$ atoms per dose. The experiments were repeated at 295, 200, and 130 to 140°K for both gases (measurements at 78°K were not reproducible, probably because of a magnetic phase change). Hydrogen at 295°K caused an initial increase ΔR in the original resistance R to a maximum $\Delta R/R \sim 20\%$, that was followed by a decrease to $\Delta R/R = 0$ and then to $\Delta R/R < 0$. A similar pattern of resistance changes was observed at 200 and 130 to 140°K with smaller changes of $\Delta R/R$, i.e., 16 and 8% respectively, but no significant difference in surface (θ) and bulk atomic ratios at which the maxima occurred, e.g., $\Delta R/R$ was a maximum for $1.6 \leq \theta \leq 1.9$. (auth)

21932 TRAPPING OF POTASSIUM ON TUNGSTEN IN THE ENERGY RANGE OF 0.5 TO 8 eV. Hurkmans, A.; Overbosch, E. G.; Los, J. (FOM-Instituut vor Atoom- en Molecuulfysica, Amsterdam). Surface Sci.; 35: No. 1, 415-424(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

The fraction of the incident atoms initially trapped by a surface (i.e., not reflected directly) was measured in a system of potassium atoms impinging on a tungsten surface. The tungsten target was a 25-μ polycrystalline wire. The measurements were performed as functions of two parameters, namely the surface temperature T, and the energy of the incident atoms E_i, in the range of 1100 to 1300 K and 0.5 to 8 eV, respectively. A simple theoretical description, based upon a cube model, is discussed and shows a good agreement with the experimental data. As an additional parameter the binding energy Q_i for K^+ adsorbed on W was determined, leading to a value $Q_i = 2.4 \pm 0.1$ eV. (auth)

21933 ENERGY DISTRIBUTION OF SECONDARY ION-ELECTRON EMISSION. Soszka, W.; Lipiec, J. (Jagiellonski Univ., Krakow). Surface Sci.; 36: No. 2, 714-724(May 1973).

The energy distribution of secondary electrons emitted when 3-kev He^+ and Ne^+ ions bombard the (100) surface of a copper single crystal and the (0001) surface of a zinc single crystal was studied. A "long magnetic lens" was employed in the energy analysis. A group of high-energy electrons (having an energy of approximately 35 eV) is found to appear in the case of bombardment with helium ions. The results are discussed on the basis of the model of autoionization of the incoming ions (helium and neon) embedded in layers near the surface. The effect of temperature and time on the energy distribution of secondary electrons is also examined. (21 references) (auth)

21934 REFLECTION–ABSORPTION INFRARED SPECTRUM OF α-CO CHEMISORBED ON POLYCRYSTALLINE TUNGSTEN. Yates, J. T. Jr.; Greenler, R. G.; Ratajczykowa, I.; King, D. A. (Univ. of East Anglia, Norwich, Eng.). Surface Sci.; 36: No. 2, 739-755(May 1973).

The infrared spectrum of chemisorbed α-CO on polycrystalline tungsten was studied using ultrahigh-vacuum techniques. The α-CO state was spectroscopically resolved into two states, designated α_1-CO (wavenumber ~2128 cm^{-1}) and α_2-CO (wavenumber ~2090 cm^{-1}). α_2-CO adsorbs predominantly in the first stages of α-CO adsorption; α_1-CO forms primarily at high α-CO coverages at the partial expense of α_2-CO. α_1-CO is found to desorb at a slightly lower temperature than α_2-CO. Both α-CO states are postulated to involve sp-hybridized carbon that is bonded to the tungsten surface. These states have previously been detected in electron impact desorption measurements, where α_1-CO was shown to liberate CO^+ and α_2-CO to liberate O^+. (25 references) (auth)

21935 SURFACE SELF-DIFFUSION OF TUNGSTEN UNDER THE INFLUENCE OF ADSORBED NICKEL. Pichaud, M.; Drechsler, M. (CNRS, Marseille). Surface Sci.; 36: No. 2, 813-816 (May 1973).

Nickel is evaporated to the tip from a Ni filament coiled around a W loop. The Ni source is calibrated: the variation of the average work function of the tip is measured as a function of time at constant flux. The variation of the activation energy of tungsten in the presence of adsorbed Ni is shown. The activation energy of surface self-diffusion of tungsten is reduced in the presence of a layer of adsorbed Ni from 3.1 eV to 0.9 eV. Field electron microscopy can contribute to solve problems of sintering. The acceleration of the sintering of tungsten by addition of Ni or a Ni halide must be a consequence of an increase of the surface self-diffusion of W by an adsorbed Ni layer of $\theta > 10^{15}$ atoms/cm^2. (MCW)

21936 ADSORPTION STATES, ADSORPTION RATES, AND DESORPTION OF OXYGEN ON RHENIUM AND MECHANISMS OF ATOMIZATION AND OXIDATION AT HIGH TEMPERATURE AND LOW PRESSURE. Weber, B.; Cassuto, A. (CNRS, Villers-Nancy, France). Surface Sci.; 36: No. 1, 81-108(Apr 1973). (In French).

Interactions of oxygen with rhenium were studied at low pressures (10^{-4} to 10^{-6} torr) in an ultrahigh-vacuum apparatus where all desorption products, including instable and condensible species are analyzed by mass spectrometry. The chemical reactions depend on the surface coverage that is fixed by an equilibrium between the rate of adsorption and the rates of desorption steps, varying with temperature and pressure. Measurements were made of these rates, independently, or directly (pressure variations after a flash, thermal desorption). When the coverage is lower than 0.7, the main reaction is oxygen atomization. For higher values, desorption of atomic oxygen is progressively replaced by desorption of rhenium trioxide, ReO_3, main product of reaction. The following mechanism, based on the kinetics of the elementary steps, experimentally isolated, gives a quantitative picture of all the phenomena, for pressures between 10^{-4} to 10^{-6} torr, and sample temperatures varying from 1500 to 2300°K: (a) dissociative adsorption of oxygen; (b) desorption of atomic oxygen; (c) desorption of trioxide, only formed by surface reaction. The different rates depend on coverage, frequency factors, and binding or activation energies. Optimization of the results in stationary conditions gives the values of these parameters. The agreement with the values obtained directly is excellent. (22 references) (auth)

21937 ADSORPTION OF SILVER ON TUNGSTEN(110). Hudson, J. B.; Lo, C. M. (Rensselaer Polytechnic Inst., Troy, NY). Surface Sci.; 36: No. 1, 141-154(Apr 1973).

Previous studies of the adsorption of metals on metals, by a mass-spectrometric molecular-beam technique were extended to the case of silver adsorbing on tungsten (110). The adsorption process was studied by both the adsorption transient technique and the flash filament technique. Two adsorbed phases were observed, having heats of desorption of 66 and 41 kcal/mol. The more tightly bound phase saturated in coverage at 6×10^{14} molecules/cm^2. The other phase showed no fixed coverage limit. A relation was found for the equilibrium total coverage at any value

of impingement rate and substrate temperature, in which the mean-stay-times for adsorption in the two adsorbed phases and the saturation coverage in the tightly bound phase are represented. It was also observed that at impingement rates greater than the equilibrium evaporation rate of the bulk crystal phase of silver, this phase nucleated and grew without requiring an observable critical supersaturation, with a material accommodation coefficient of unity, and epitaxially with the substrate. (auth)

21938 CHEMISORPTION OF H_2 ON W(100): ABSOLUTE STICKING PROBABILITY, COVERAGE, AND ELECTRON-STIMULATED DESORPTION. Madey, T. E. (National Bureau of Standards, Washington, DC). Surface Sci.; 36: No. 1, 281-294(Apr 1973).

Measurements of both the absolute sticking probability near normal incidence and the coverage of H_2 adsorbed on W(100) at ~300°K were made using a precision gas-dosing system; a known fraction of the molecules entering the vacuum chamber struck the sample crystal before reaching a mass spectrometer detector. The initial sticking probability $\mathscr{S}_0$ for H_2/W(100) is 0.51 ± 0.03; the hydrogen coverage extrapolated to $\mathscr{S}_0 = 0$ is 2.0×10^{15} atoms cm^{-2}. The initial sticking probability $\mathscr{S}_0$ for D_2/W(100) is 0.57 ± 0.03; the isotope effect for sticking probability is smaller than previously reported. Electron-stimulated-desorption (ESD) studies reveal that the low coverage β_2 hydrogen state on W(100) yields H^+ ions upon bombardment by 100-eV electrons; the ion desorption cross section is $\sim 1.8 \times 10^{-23}$ cm^2. The H^+ ion cross section at saturation hydrogen coverage when the β_1 state is fully populated is $\ll 10^{-25}$ cm^2. An isotope effect in electron-stimulated desorption of H^+ and D^+ was found. The H^+ ion yield is $\gtrsim 100\times$ greater than the D^+ ion yield, in agreement with theory. (29 references) (auth)

21939 WORK FUNCTION IN FIELD EMISSION: THE (110) PLANE OF TUNGSTEN. Todd, C. J.; Rhodin, T. N. (Cornell Univ., Ithaca, NY). Surface Sci.; 36: No. 1, 353-369(Apr 1973).

Field emission for the (110) plane of field evaporated and thermally annealed tungsten has been restudied with particular reference to the significance of interpretation of the work function. It is concluded that the results obtained in field emission are consistent with results from non-field emission methods where the important variable of the local field is adequately considered. Possible contribution of other factors to measurement of the clean-surface work function is also discussed. (38 references) (auth)

21940 MULTIPLE-SCATTERING RESONANCES WITHIN ATOMIC MONOLAYERS IN LEED FROM Re(0001). Zimmer, R. S. (Univ. of Warwick, Coventry, Eng.). Surface Sci.; 36: No. 2, 430-453(May 1973).

It is shown theoretically and corroborated experimentally that multiple-scattering resonances in monolayers of atoms can produce large effects in LEED beam intensities near thresholds of diffracted-beam emergence. Scattering in many orders of partial waves is taken into account. The effects are confined by inelastic-collision damping in the valence-electron gas to energies below ~200 eV, and to within ~0.5 $Å^{-1}$ of points of high order of rotational symmetry in the two-dimensional Brillouin zone (at which several beams can emerge simultaneously). To facilitate experimental corroboration, a method is developed that isolates monolayer-scattering effects from competing effects due to scattering between layers of atoms and to occasional atomic-scattering resonances. Variation of a diffracted-beam intensity on account of these extraneous mechanisms can be largely avoided along trajectories of the primary-beam wave vector that (a) lie along lines of constant diffraction vector close to their points of tangency to arcs of constant energy, and which also lie within qualitative boundaries such that (b) energy is greater than approximately 70 eV, and (c) the combined angular deviation of the incident and diffracted beams from the normal to the surface is small. Such trajectories are roughly perpendicular to the commonly chosen line of increasing energy at normal incidence. Recognition of monolayer-scattering effects is aided by development of a very simple and approximate calculation within the qualitative boundaries set by conditions (b) and (c). Finally, experimental corroboration is obtained in accordance with diffraction conditions (a), (b), and (c) in LEED intensities from Re(0001) (Z = 75). For this surface the lower limit of energy in condition (b) is 50 eV, and the upper limit of the combined angular deviation in (c) is 30°. (35 references) (auth)

21941 HYDROGEN ISOTOPE REPLACEMENT REACTIONS ON RHENIUM. Gasser, R. P. H.; Morris, G.; Szczepura, A. K. (Physical Chemistry Lab., Oxford). Surface Sci.; 36: No. 2, 494-512(May 1973).

The existence of a mobile equilibrium at room temperature between part of the hydrogen adsorbed on rhenium and gaseous hydrogen is demonstrated by the easy exchange of isotopes between the adsorbed layer and the gas phase. The adsorbed gas is desorbed as a mixture of homonuclear molecules (of H_2 or D_2) and of the isotopically mixed species (HD). However, the replacement reactions are not symmetrical; there is a greater proportion of HD in the desorbed gas when deuterium is replaced by hydrogen than in the converse reaction. This kinetic isotope effect is attributed to differences between the zero-point energies of the various hydrogen-containing species. Quantitative agreement between the shapes of the experimentally observed desorption curves and calculated curves is obtained if the zero-point energy of the bond between a surface rhenium atom and deuterium is assigned the value 2.6 kcal $mole^{-1}$. (auth)

21942 SURFACE SENSITIVITY AND ANGULAR DEPENDENCE OF X-RAY PHOTOELECTRON SPECTRA. Fraser, W. A.; Florio, J. V.; Delgass, W. N.; Robertson, W. D. (Yale Univ., New Haven). Surface Sci.; 36: No. 2, 661-674(May 1973).

By using an ultrahigh-vacuum x-ray photoelectron spectrometer designed specifically for surface studies, the surface sensitivity (ratio of surface to volume signal) of the technique was found to be enhanced by approximately one order of magnitude at low angles of electron emission measured from the surface plane. While the Mo($3d_{\frac{5}{2}}$) peak intensity from a clean polycrystalline target of molybdenum was independent of angle, the Cs($3d_{\frac{5}{2}}$) intensity from an adsorbed cesium layer on molybdenum increased and the Mo($3d_{\frac{5}{2}}$) signal from the molybdenum substrate decreased as the angle of emission was decreased. A model is presented to account for the angular dependence and it is proposed that the angular dependence of spectral intensities can be used to differentiate surface from bulk species. (auth)

21943 STUDY OF GAS–SOLID CHEMICAL INTERACTIONS BY THE MOLECULAR-BEAM TECHNIQUE. V. Reactions of O_2 and CO with Polycrystalline Strips of Ta. Pacia, N.; Lintz, H. G.; Pentenero, A. (CNRS, Villers-Nancy, France). Surface Sci.; 36: No. 2, 701-713(May 1973). (In French).

The reflection of a noble-gas (helium) molecular beam was used to study the superficial reactions of oxygen and carbon monoxide with polycrystalline tantalum. The fraction of the incident beam that is specularly reflected gives direct information on the formation of an oxygen chemisorbed layer and only a single apparent binding state for oxygen chemisorbed on tantalum was observed. The initial value of the sticking coefficient of oxygen on clean polycrystalline tantalum is 0.86, decreasing rapidly during the formation of a chemisorbed layer. The specularly reflected fraction of the incident beam is also modified by the chemisorption of carbon monoxide and this modification would confirm the dissociative character of the CO chemisorption of tantalum. The influence of the partial pressure of CO on the temperature at which the surface is completely covered by the products of the dissociative chemisorption of CO shows that the coverage becomes equal to unity at temperatures at which the solubility limit of CO is attained and tantalum carbide is formed. (21 references) (auth)

21944 KORROZIONNAYA STOIKOST' NERZHAVEYUSHCHIKH STALEI I CHISTYKH METALLOV. (Corrosion Resistance of Stainless Steel and Pure Metals). Tufanov, D. G. Moscow; Metallurgiya (1973). 352p.

The present edition is supplemented with data on the corrosion resistance of stainless steel and pure metals. Indexes on the corrosion resistance of stainless steel, pure metals, and highly alloyed systems in many chemical media of different concentrations and at different temperatures are included. The chemical composition, the mechanical properties of the stainless steel, thermal processing regimes, methods for scale removal, etc., are given. (321 references) (tr-auth)

21945 CLIMB OF SUPER-JOGS OF BURGERS VECTOR $\frac{1}{3}\langle 11\bar{2}0\rangle$ DURING THE OXIDATION OF CADMIUM. G'sell, C.; Champier, G. Mater. Sci. Eng.; 12: No. 3/4, 203-208(1973).

The evolution of dislocation configurations was observed by x-ray topography in large single crystals of cadmium subjected to oxidation by air at room temperature. In addition to the climb of the dislocations of Burgers vector [0001], this study shows a mechanism which has not yet been observed: the climb of super-jogs of Burgers vector $\frac{1}{3}\langle 11\bar{2}0\rangle$ lying at the tip of edge dipoles. The supersaturation of vacancies due to the oxidation of the metal allows one to take the experimental observations into account. (6 figures) (auth)

Preparation and Fabrication

Refer also to abstracts 20947, 23969, 24014, 24042, and 24043.

21946 (FOA-4-4510-A-2) TURNING OF UNALLOYED PLUTONIUM. Hedlund, B. (Forsvarets Forskningsanstalt, Stock-

holm (Sweden)). Sep 1972. 23p. (In Swedish). Dep. NTIS (U.S. Sales Only) $3.25.

The possibility of turning unalloyed plutonium was investigated. Loose-edge formation was shown to be an important problem. A number of different cutting materials were examined in combination with variable cutting data. Of the examined materials, high-speed steel was most disposed for loose-edge formation and hard metal with high content of titanium less disposed. Diamond tools get no loose edge but have limited use because the high cutting power at low-speed cutting will break the edge. (2 tables, 15 figures) (SW)

21947 (RFP-1840) GRAIN REFINEMENT TRIAL IN CAST BERYLLIUM BY MOLD OSCILLATION. Fergason, D. L.; Heiple, C. R. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 6 Aug 1973. Contract AT(29-1)-1106. 6p. Dep. NTIS $4.00.

Unsuccessful efforts to modify the grain size of cast beryllium by mold oscillation during solidification are described. No change in grain size or growth pattern could be induced within the range of oscillation frequency (up to 72 reversals per minute) and amplitude (up to about 75° between reversals) possible with the apparatus. (auth)

21948 INTERACTION OF HIGH TEMPERATURE STRENGTH AND WELDABILITY. Lessmann, G. G.; Gold, R. E.; Begley, R. T. (Westinghouse Electric Corp., Pittsburgh). Weld. J. (N. Y.); 52: No. 7, 312s-321s (Jul 1973).

New and improved alloys are accepted by users with reticence since they recognize that improvements in one property may reflect compromise in others. The most common concern is the balance between fabricability and strength, primarily to assure that weldability is retained with higher strength. The relationship between strength and weldability of alloys designed for high temperature use is examined. An understanding of the subtleties in the relation between welding responses, high temperature strength, flow, and fracture is presented. This provides the materials engineer with another tool to aid in selection and evaluation of advanced alloys for his applications. Weldability results were interpreted in terms of the relationships developed from experimental studies. Of particular interest, the occurrence of underbead cracking in multipass plate weldments could be rationalized in terms of the apparent balance (or imbalance) between grain boundary and matrix strength at high temperatures. Correlation was also obtained by use of the Varestraint test, despite the fact that classic hot cracking was not involved. Hence, this test was shown to be responsive to hot ductility problems as well as classic "hot shortness." The particular mode of underbead cracking studied resulted from the transition mode behavior. Above 0.5 Tm deformation occurs predominantly by grain boundary shear. Factors which decrease grain boundary strength in this temperature regime degrade creep properties and cause underbead crackling. Conversely, more balanced grain boundary strength relative to the matrix enhances creep strength and eliminates underbead cracking. (auth)

21949 GORYACHIE TRESHCHINY PRI SVARKE ZHAROPROCHNYKH SPLAVOV. (Hot Cracking During Welding of Heat-Resistant Alloys). Shorshorov, M. Kh.; Erokhin, A. A.; Chernyshova, T. A.; Kotov, G. N.; Russiyan, A. V. Moscow; Mashinostroenie (1973). 224p.

The basic theory of the resistance of metals and alloys during fusion welding, the criteria and processes for its evaluation, and the metallurgical and technological means of the prevention of hot cracking in welded junctions in heat-resistant alloys of Fe, Ni, Al, and refractory metals are discussed. Characteristics of the crystallization of metal seams and processes in the zone near the seam responsible for the formation of chemical and physical inhomogeneities and the production of hot cracking are analyzed. The mechanisms of this intercrystalline fracture are examined. Data on the effects of the alloying system, the basic alloying elements and admixtures, and processes and technology of welding are generalized to the resistivity of heat-resistant alloy to the formation of hot cracking. Recommendations are made on the selection of additional materials, electrodes, and fluxes, as well as on an efficient regime and welding technology and thermal treatment. (133 references) (tr-auth)

21950 PROPERTIES OF rf-SPUTTERED β-Ta FILMS. Lau, S. S.; Mills, R. H. (Bell Telephone Labs., Allentown, PA). Phys. Status Solidi (a); 17: No. 2, 609-620(16 Jun 1973).

The properties of Ta films deposited at rates ranging from 85 to 540 Å/min by rf diode sputtering were investigated. The resistivity and the impurity in the films were found to decrease with increasing deposition rate and the residual stresses in the films were found to depend approximately linearly on the deposition rate. Investigation of the stress profile in the films revealed that the stress reached a maximum within a few hundred angstroms from the substrate/film interface and decreased to almost constant values as the film grew thicker than 1500 Å. The structure of films deposited at low rates (<350 Å/min) were found to be β-Ta and a mixture of β and bcc Ta for films deposited at high rates. The quality of the capacitors based on rf-sputtered Ta films deposited over a wide range of rates was equivalent to that of a control group based on β-Ta deposited by dc sputtering. (auth)

21951 INTERACTION OF GASES AND CARBON WITH REFRACTORY METALS. Gebhardt, E.; Hoerz, G.; Fromm, E. pp 111-128 of Fiziko-khimicheskie osnovy metallurgicheskikh protessov. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Changes in the properties of refractory metals, when nitrogen and oxygen are dissolved in them, are considered. A survey is made of certain gas absorption and liberation reactions that are important in vacuum metallurgy, including an analysis of states and thermodynamic equilibria. A detailed analysis is made of the interaction of nitrogen and oxygen with the refractory metals vanadium, niobium, tantalum, molybdenum, and tungsten. The relations characterizing the interaction of carbon and carbon monoxide with refractory metals are briefly considered. On the basis of the quantitative relations presented, an estimate is made of the minimum gas contents achievable during high-vacuum annealing and the measures required to obtain a particular gas content are determined. (IAA)

21952 EFFECT OF THE ELECTRON-BEAM THERMAL WELDING CYCLE ON SEAM FORMATION AND PROPERTIES OF NIOBIUM (VN-2AE) AND STEEL (Kh18N10T) WELD JOINTS. Sivov, E. N.; D'yachenko, V. V. (Moscow Aviation Technological Inst.). Svar. Proizv.; No. 4, 11-13(Apr 1973). (In Russian).

In modeling the process of welding by means of applying a drop of melted steel on the surface of solid niobium it was established that for formation of strong chemical bonds at the solid/liquid interface boundary without development of an intermetallide substrate it is required that the niobium heating temperature in the zone of contact with the molten steel be in the limits of 1100 to 1600°C for not more than several seconds of contact. In electron-beam welding, a similar cycle can be obtained in the case when the niobium heating source is the edge of the molten steel. In electron-beam welding, it is necessary to place the steel so as to prevent its direct action on the niobium surface. From weld tests, it was found that heating niobium with a thickness of 0.3 to 0.5 mm up to 1600°C and with a thickness of 0.5 to 1.0 mm up to 1500°C does not cause the formation of an intermetallide substrate. A satisfactory strength of the weld joints can be achieved if the substrate is absent or the average thickness of a discontinuous substrate does not exceed 2.0 microns. The types of joints and optimum welding process were determined which provide weld seams of a given shape and satisfactory properties. The boundary angle of wetting for the crystallizing seam is the criterion for evaluating the weld joint quality, and a satisfactory strength of the joint occurs for wetting angles of 45 to 70°. (JPRS)

21953 EFFECTIVE AND ECONOMIC USE OF THE SPECIAL CHARACTERISTICS OF ALUMINIUM AND ITS ALLOYS. Proceedings of an International Conference, Zurich, Switzerland, September 25–28, 1972. Monograph and Report Series, No. 35. London; Institute of Metals (1972). 249p.

Thirty six papers were presented, covering all aspects of aluminium production and fabrication, testing and quality control, properties of specially developed alloys, and present and potential applications. One paper, on the application of aluminum in the construction of particle accelerators, was in NSA scope and a separate abstract for it was prepared. (UK)

For abstract of an individual paper see: 21954.

21954 APPLICATION OF ALUMINIUM IN THE CONSTRUCTION OF PARTICLE ACCELERATORS. Frei, H. (Schweizerisches Institut fuer Nuklearforschung, Zurich). pp 184-185 of Effective and Economic Use of the Special Characteristics of Aluminium and Its Alloys. London; Inst. of Metals (1972).

From proceedings of international conference on effective and economic use of the special characteristics of aluminium and its alloys; Zurich, Switzerland (25 Sep 1972).

It is stated that apart from its normal advantages, such as low specific weight, resistance to corrosion and good machinability, aluminum is useful to accelerator builders when they need nonmagnetic components placed close to the large electromagnets. At high levels of radiation aluminum oxide is useful as an insulator: conductors made of anodically oxidized pure aluminum are embedded in aluminum plates, the two contacting surfaces of which are treated by electrolytic oxidation. Aluminum is more resistant than copper to the corrosion induced by intense radiation. A description is given of the construction of rf resonators, using aluminum, for a proton beam of high intensity with a final energy of 600 MeV. The method of construction ensured that

the aluminum surface remained uncontaminated, and the surface had a very low outgassing rate. A vacuum of better than 0.1 mN/m^2(10^{-6} mbar) was achieved. (UK)

21955 METHOD OF MACHINING A STANDARD DEFECT FOR FAST REACTOR FUEL CLADDING TUBE. Oishi, Y.; Kagaya, K.; Inagaki, K. (Tohoku Univ., Sendai). Tohoku Daigaku Kagaku Keisoku Kenkyusho Hokoku; 21: No. 2-3, 75-88(Mar 1973). (In Japanese).

Currently, the detection of flaws in fuel cladding tubes is made by a simultaneous use of ultrasonic flaw detection and the eddy-current method for flaw detection. In these nondestructive inspections, standard artificial defects for highly accurate calibration are required to obtain correct sizes of such defects and their depths in particular. The shape of the cross section of the standard defect is described and illustrated along with an improved defect shape. Widths are required to be narrowed to less than 30 μ from conventional 50 μ or more. The study is directed to research and development of a method to machine standard defects for the JOYO's fuel cladding tube. (auth)

21956 EFFECT OF IMPURITIES ON THE HYDROGEN EMBRITTLEMENT CHARACTERISTICS OF A CADMIUM PLATING SOLUTION. Roth, H. P. Plating; 59: No. 8, 765-772(Aug 1972).

A number of inorganic ions and organic compounds, considered to be common impurities normally found in the bath, were added to the cadmium plating solution in known concentrations. The effects of these impurities on hydrogen embrittlement characteristics were measured with the Lawrence Hydrogen Detection Gauge. The concentrations of the impurities tested (except a brightener) had little or no influence upon the hydrogen embrittlement properties of the cadmium plating process up to the levels that caused reduced cathode efficiency. Thus from an embrittlement standpoint, the unbrightened cadmium cyanide solution is quite tolerant of contamination. (Corrosion Abstr.)

21957 HIGH-PRESSURE SYNTHESIS OF LUTETIUM TRILEAD. Miller, K.; Hall, H. T. (Brigham Young Univ., Provo, UT). J. Less-Common Metals; 32: No. 2, 275-278(Aug 1973).

The compound $LuPb_3$ was synthesized at 67 to 88 kbar and 700 to 1100°C. The $LuPb_3$ is face-centered cubic in structure ($AuCu_3$ type) with a cell parameter of 4.786 Å. The $LuPb_3$ could not be prepared at room pressure, but the previously indexed trilead compounds of Tb, Ho, Er, and Tm could be prepared by either room pressure or high-pressure techniques. (auth)

21958 PREPARATION OF ZIRCONIUM-NIOBIUM ALLOY BY CARBIDE-OXIDE REACTION. Venkataramani, R.; Garg, S. P.; Sundaram, C. V. (Bhabha Atomic Research Centre, Trombay, India). J. Less-Common Metals; 32: No. 2, 279-287(Aug 1973).

The direct preparation of Zr-Nb master alloys (with 30 to 40%) by reaction between ZrC and Nb_2O_5 was investigated. By progressive heat soaking of the pelletised charge under a dynamic vacuum, followed by electron-beam melting, Zr-Nb alloys low in carbon and oxygen were prepared. The influence of different process parameters, such as initial oxygen excess in the charge, temperature, and time of heat soak, on the final purity of the alloy was examined. The thermodynamics of the reaction are discussed. The overall material balance for the reaction indicates removal of oxygen both through carbothermic reduction (as CO) and through sacrificial deoxidation (as ZrO). (18 references) (auth)

21959 EFFECT OF DRAWING PARAMETERS ON THE THICKNESS VARIATION OF THE TANTALUM COATING OF BIMETALLIC TANTALUM/NIOBIUM WIRE BARS. Masterov, V. A.; Safonova, G. G.; Kovaleva, N. M. Kuznechno Shtampovochnoe Proizvod.; No. 10, 8-10(Oct 1972). (In Russian).

Details are given of statistically controlled experiments designed to determine the optimum conditions of wire drawing for bimetallic Nb/Ta wires to obtain a uniform thickness of Ta. The bars used consisted of Nb (30 mm dia) surrounded by a Ta tube of 4.25 mm wall thickness. (Metals Abstr.)

21960 DETERMINATION OF THE TEMPERATURE DISTRIBUTION AT THE COMMENCEMENT OF DEFORMATION WHEN EXTRUDING REFRACTORY METALS. Golovachev, Yu. M. Kuznechno Shtampovochnoe Proizvod.; No. 10, 34-36(Oct 1972). (In Russian).

A mathematical analysis is presented for the heat flow and temperature distribution in tubes of W, Mo, or other refractory metals or alloys during hydraulic extrusion. (Metals Abstr.)

21961 SUPERCONDUCTIVITY AND ELECTRONIC STRUCTURE OF SUPERPURE NIOBIUM. I. Preparation of Superpure Niobium. Bartel, L.; Bertel, K. Kh.; Fischer, K.; Gebel, R.; Gyuntsler, G.; Yurich, M.; Neimann, V.; Kuntse, I.; Myul, P.; Oppermann, Kh.; Petru, R.; Sobe, G.; Veise, G.; Visner, U. Fiz. Metal. Metalloved.; 35: No. 5, 921-931(1973). (In Russian).

A method was described for the preparation of superpure microcrystals of Nb, consisting of the following steps: preparation of superpure niobium oxide, chlorination, thermal decomposition, electron-beam fusion, and annealing in ultrahigh vacuum. The amount of basic impurities was controlled after each step of the purification by different methods. The best samples have a resistance ratio $\alpha \approx 10^5$. (tr-auth)

21962 STRUCTURAL CHANGES DURING PLASTIC DEFORMATION AND ANNEALING OF TUNGSTEN SINGLE CRYSTALS. Nobikov, I. I.; Tiraspol'skii, V. I. (Moscow Inst. of Steel and Alloys). Fiz. Metal. Metalloved.; 35: No. 5, 1040-1044(1973). (In Russian).

The structural changes during rolling and hydroextrusion and subsequent annealing were analyzed. The characteristics of the subcritical, critical, and supercritical intervals of the stages of plastic deformation of W monocrystals are given. (tr-auth)

21963 ELECTROCHEMICAL BEHAVIOR OF CHROMIUM, MOLYBDENUM, AND TUNGSTEN. Vas'ko, A. T.; Kosenko, V. A. (Inst. of General and Inorganic Chemistry, Kiev). Dopov. Akad. Nauk Ukr. SSR, Ser. B; No. 6, 530-533(Jun 1973). (In Ukrainian).

A relationship was established between the electrochemical behavior of chromium, molybdenum, and tungsten and their electronic structure. The current efficiency of molybdenum and tungsten in their electrodeposition with the iron triad metals is shown to decrease with a lowering in donor properties of precipitant metals. (auth)

21964 INVESTIGATIONS OF ISOTHERMAL CHEMICAL TRANSPORT. Nickl, J. J.; Koukoussas, J. D.; Muehlratzer, A. (Univ., Munich). J. Less-Common Metals; 32: No. 2, 243-273(Aug 1973). (In German).

Isothermal chemical transport on recrystallization and the formation of solid-solution alloys, carbides, and intermetallic compounds is discussed. The transport medium was either a reactive vapor phase containing a halogen or a sodium chloride melt containing bromine or iodine. The transport direction and the transport rates are considered in detail for the system Cu-Ni-halogen. Technological aspects of isothermal transport, such as surface finishing and surface coating, are pointed out. (10 tables, 8 figures, 52 references) (auth)

21965 PRESSURE AND TEMPERATURE FORMATION OF A_3B COMPOUNDS. I. Nb_3Si and V_3Al. Leger, J. M. (CNRS, Bellevue, France); Hall, H. T. J. Less-Common Metals; 32: No. 2, 181-187(Aug 1973).

The formation of Nb_3Si and V_3Al was investigated under high pressures and temperatures (20 to 70 kbar, 1000 to 2000°C). In no case was it possible to synthesize a compound with the cubic A15 structure, but in both cases a body-centered cubic structure, previously unknown, was obtained. Other new compounds of vanadium with aluminum are also reported. The appearance of the A15 structure is discussed and it is suggested that it may be possible to synthesize cubic A15 V_3Al under very high pressures but that cubic A15 Nb_3Si should not form at any pressure. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 20904, 20905, 20907-20909, 21876, 22700, 22713, 22960, 22964, 22970, 23470, 23476, 23493, 23494, 23535, 23536, 23881, 23908, 23928, 23931, 23946-23950, 23954, 23960, 23965, 23966, 23977, 23987, 23989, 23990, 23992, 23993, 23995, 24010-24013, 24017, 24044, 24045, 24052, 24055, and 24061.

21966 (BARC-660) DEFORMATION MECHANISMS IN ZIRCALOY-2 AT LOW TEMPERATURES. Samuel, K. G.; Rodriguez, P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

The effect of temperature and strain rate on the yield and flow behavior of Zircaloy-2 was investigated between 77 and 660°K. In addition to uninterrupted tensile tests at a nominal strain rate of 2.626×10^{-4} sec^{-1}, strain-rate change tests involving ten-fold changes from the above base strain rate were also carried out. The activation parameters associated with thermally activated dislocation motion were evaluated. The study revealed that the temperature and strain-rate dependence of flow stress in Zircaloy-2 between 77 and 660°K arises from the interstitial solutes (mainly ~1100 ppM oxygen). Substitutional alloying additions like Sn contribute only to the athermal component of flow stress. The activation energy (for dislocation motion) vs temperature data yielded two linear regions as were obtained in earlier studies on zirconium-oxygen alloys, interpreted as due to two consecutive

deformation mechanisms in the two regions of temperature. It is suggested that the anomalous variation of thermal activation parameters with temperature above 300°K arises, more likely, from dynamic strain aging effects and/or from variations in internal stress with temperature. It is also possible that a single mechanism is not rate controlling above 300°K. (6 figures, 29 references) (auth)

21967 (BDX-613-936) JOINING MAGNETIC ALLOY 49Fe–49Co–2V to 304L STAINLESS STEEL. Technical Spinoff Report. Jarboe, D. M. (Bendix Corp., Kansas City, Mo.). Aug 1973. Contract AT(29-1)-613. 18p. Dep. NTIS $4.00.

A vacuum-furnace brazing process using oxygen-free copper as the filler metal has been developed for joining 49Fe–49Co–2V soft magnetic alloy and 304L stainless steel. The process eliminated the hot-cracking problem associated with electron beam welding these materials. Joints produced by this process have withstood shear loads in excess of 2000 pounds (8896N). (auth)

21968 (COO-3084-25) COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF METALS. Technical Progress Report, July 1972–June 1973. Freund, L. B.; Gurland, J.; Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). Jul 1973. Contract AT(11-1)-3084. 14p. Dep. NTIS $3.00.

New insight has been obtained on the problem of cleavage initiation in mild steel by coupling the critical stress-fracture criterion with a finite microstructurally significant size scale. Work has continued on interpreting macroscopic crack toughness parameters, such as K_{Ic} in terms of microstructural separation mechanisms, both theoretically and experimentally. A potentially very useful classification of crystals as brittle or ductile is proposed on the basis of the sign of the energy barrier for the emission of dislocations from the tip of a loaded crack. A project on diffusive mechanisms of crack growth and cavity growth at elevated temperature has been started with the aim of contributing to the theory of diffusional creep rupture. Studies continue on the modeling of ductile rupture processes involving the large plastic growth and coalescence of cavities. In particular, a finite-element computational program for problems of large plastic deformation and instability has been developed and is being applied to some test cases. (auth)

21969 (COO-3158-23) STUDY OF VACANCY DEFECTS IN QUENCHED TUNGSTEN BY COMBINED ELECTRICAL RESISTIVITY AND FIELD ION MICROSCOPY. Park, J. Y.; Huang, H. C. W.; Berger, A. S.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Jul 1973. Contract AT(11-1)-3158. 21p. (CONF-730813-7). Dep. NTIS $3.25.

From conference on defects and defect clusters in b.c.c. metals and their alloys; Gaithersburg, Maryland, USA (14 Aug 1973).

High-purity single-crystal tungsten rods with resistance ratios $R(273°K)/R(4.2°K) \simeq 3 \times 10^4$ were prepared by electron-beam melting. Thin single-crystal wires of 63-μm dia, obtained from these rods by electropolishing, were then heated resistively in an ultrahigh-vacuum manifold and "radiation quenched" by switching off the heating current. Initial quench rates as large as ~30,000°K sec^{-1} were achieved. No significant changes were found in the annealed specimen base resistance at 4.2°K as a result of multiple quenching and annealing cycles. It is believed that this quenching method represents an ultraclean technique that maintained the specimen free of impurities during quenching. Appreciable quenched-in resistivity increments were obtained in all cases by quenching from temperatures in the range 2700 to 3565°K. However, the increments quenched into one specimen were lower by a factor ~4 than those obtained in another specimen subjected to less initial purification. Furthermore, the increments obtained by extrapolation to ∞ quenching rate were smaller by a factor ~3 than those obtained previously by Gripshover, et al., by a similar extrapolation procedure. It appears that these differences are real and cannot be due to intrinsic quenched-in vacancy defects. Instead, the results are believed to be due to the presence of relatively large concentrations of quenched-in impurities (along with vacancies) in all of the specimens with the possible exception of the most pure specimen used in the present work. The impurities evidently went in and out of solution during quenching and annealing. Field ion microscope (FIM) specimens were prepared from the gage lengths of the quenched specimens and were examined atom by atom by the method of pulsed field evaporation for the presence of quenched-in defects. So far, 778,000 sites were examined in one relatively impure specimen quenched from 3300°K. Eighteen dark spot defects were found which could have been either vacancies or impurity atoms. This result establishes an upper limit of $\sim 2 \times 10^{-5}$ for the concentration of quenched-in vacant sites. The investigations are still in progress. (10 figures). (auth)

21970 (DNPL/R-26, pp 278-279) OPTICAL PROPERTIES OF SINGLE CRYSTALS OF Cd, Cr, Nb, LaF_3, AND PrF_3. Lynch, D. W.; Olson, C. G. (Iowa State Univ. of Scl. and Tech., Ames). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

Synchrotron radiation from the University of Wisconsin Physical Sciences Laboratory storage ring was used to measure the reflectivity of a number of single crystals. Special attention was paid to the elimination of scattered light. By careful surface preparation, and minimizing exposure to air, the data on metal single crystals reveal more structure than data on evaporated films. In several cases the reflectivity of the oxide was measured separately and corrections applied to the single data. Whenever possible, Kramers–Kronig analysis was performed on the data and the resulting dielectric constant used to compute the reflectivity at 45 and 60° for comparison with measurements. (auth)

21971 (JUL-935-FF) INVESTIGATION OF THE FLUCTUATIONS IN THE DEUTERIUM DISSOLVED IN NIOBIUM BY MEANS OF NEUTRON SCATTERING. Conrad, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Mar 1973. 74p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

The diffuse scattering of subthermal neutrons was measured on a deuterated niobium single crystal at three different concentrations (2.3, 9.8, and 18.0 atom per cent) and at numerous temperatures between 20 and 308°C. The elastic interaction energy of the dissolved deuterium was determined in three symmetry directions of the host crystal ([100], [110], and [111]) from the temperature dependence of scattering intensity with small impulse repeaters in the α-phase of the NbD_x system. This interaction energy is anisotropic and in all three symmetry directions is considerably smaller than the value u = 200 MeV, obtained from macroscopic measurements. The neutron scattering gave as an average value of the results for the different concentrations 30 ± 14 MeV, 36 ± 20 MeV and 81 ± 33 MeV for the three above-mentioned directions. The results were interpreted as a consequence of the elastic nature of the interaction. From the position of a line in the energy spectrum, the energy of first-excited oscillator level of deuterium to 69 ± 18 MeV was determined, which represents an isotope effect compared with the value for light hydrogen (114 ± 6 MeV). A super-structure reflex was found in the β-phase of the NbD system, and the temperature dependence of the reflex intensity was measured. The temperature of the triple point for NbD was 90 ± 2°C, whereas from the phase diagram for NbH it is about 70°C. (GE)

21972 (LBL-1666, pp 215-220) HIGH-RESOLUTION STUDY OF ISOMER SHIFTS OF THE 6.2-keV GAMMA RAYS OF ^{181}Ta. Kaindl, G.; Salomon, D.; Wortmann, G. May 1973.

In nuclear chemistry annual report, 1972.

21973 (LBL-1666, pp 223-225) STUDY OF ELECTRIC QUADRUPOLE HYPERFINE INTERACTIONS WITH THE 6.2-keV GAMMA RESONANCE OF ^{181}Ta. Kaindl, G.; Salomon, D. May 1973.

In nuclear chemistry annual report, 1972.

21974 (LBL-1666, pp 228-231) ISOMER SHIFTS OF THE 84.3-keV GAMMA RAYS OF ^{170}Yb. Kaindl, G.; Russel, P. B. May 1973.

In nuclear chemistry annual report, 1972.

21975 (LBL-1666, pp 232-234) CHANGE OF THE NUCLEAR CHARGE RADIUS IN EVEN–EVEN YTTERBIUM ISOTOPES. Kaindl, G.; Russel, P. B.; Hanna, S. S. May 1973.

In nuclear chemistry annual report, 1972.

21976 (LBL-1801) STRUCTURE AND PROPERTIES OF Fe–Mo–C STEELS. Clark, R. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-eng-48. 64p. Dep. NTIS $5.25.

Thesis.

The microstructures of a series of vacuum melted Fe–Mo–C and Fe–Mo–Co–C steels were investigated using transmission electron microscopy. The correlating mechanical properties of these steels were examined by fracture toughness (K_{Ic}) tests, Charpy V-notch impact tests, tensile tests, and hardness measurements. Examinations of each alloy were conducted in the as-quenched fully martensitic condition as well as martensites quenched and tempered for one hour at 400 and 600°C. Martensite-start (M_s) temperature measurements conducted on each alloy showed that, at constant carbon content, increasing Mo content decreased the M_s temperature; however, addition of Co to a given Fe–Mo–C steel had no noticeable effect on the M_s temperature. The two 0.4% carbon steels having a high M_s temperature had approximately one-half the amount of transformation twinning

associated with the two 0.4% carbon steels having higher Mo contents and lower M_s temperatures. The fracture toughness of the steels with less twinning was markedly superior to the toughness of those steels with more heavily twinned microstructures. The toughness of Fe–Mo–C steels was superior to that of similar steels containing a cobalt addition. Steels with higher M_s temperatures exhibited more auto-tempered Fe_3C than steels with lower M_s temperatures, as expected. Tempering at 400°C resulted in Widmanstatten precipitation of Fe_3C, as well as heavy lath boundary precipitation of Fe_3C, in all alloys. In addition, a MoC precipitate was identified in all specimens tempered at 400°C. The 600°C tempering treatment resulted in spheroidization of Fe_3C precipitates and resolution of the Fe_3C as Mo_2C precipitated. Resolution of Fe_3C was most extensive in the higher Mo content steels. The Fe–Mo–C system exhibits secondary hardening with the precipitation of Mo_2C after tempering at 600°C. This secondary hardening is generally associated with a reduction in toughness. Addition of Co to Fe–Mo–C steels inhibited or eliminated the secondary hardening effect normally observed. Toughness, however, did not improve and in fact decreased with Co additions. It is concluded that Co additions are detrimental to Fe–Mo–C steels. Based on microstructural examinations, a hypothesis as to why Co has this affect is presented. An optimum Mo content for 0.4% carbon Fe–Mo–C steels is determined from the mechanical testing data and explained by the correlating microstructural features. (auth)

21977 (ORNL-TM-4238) MECHANICAL PROPERTIES AND INTERSTITIAL CONTAMINATION IN A MOLYBDENUM-BASE ALLOY, TZM. Liu, C. T.; Inouye, H. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 26p. Dep. NTIS $3.50.

The deformation and fracture behavior of TZM (Mo–0.5% Ti–0.08% Zr–0.03% C) were studied after exposures at 825 and 1000°C to low-pressure O_2, CO, H_2O, and a simulated radioisotope thermoelectric generator environment. TZM showed an uptake of oxygen on exposure to these environments. Analysis of the results indicates that a diffusion process controls the kinetics of the oxygen absorption at 825°C while both diffusion and chemisorption processes affect the rate at 1000°C. Exposed TZM also exhibited a small initial increase in carbon content followed by a decrease. Decarburization became significant only after extended exposure at 1000°C. The mechanical properties of both exposed and heat-treated specimens were determined at temperatures to 1316°C. TZM specimens showed an increase in strength and a linear decrease in ductility with oxygen content. Exposed TZM lost its ductility completely at an oxygen level of 300 ppM at room temperature, 1093, and 1316°C, but 500 ppM was required at 825°C. The ductility of embrittled TZM was increased significantly with heat treatment at high temperatures and was almost completely restored after annealing for 15 min at 1700°C. The change in mechanical properties is discussed in terms of internal oxidation and precipitation of various forms of oxides. (auth)

21978 (ORO-3912-21) COMPUTER EXPERIMENT STUDIES ON MECHANISMS FOR IRRADIATION-INDUCED-DEFECT PRODUCTION AND ANNEALING PROCESSES. Progress Report, January 1–March 31, 1973. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh). Apr 1973. Contract AT(40-1)-3912. 26p. Dep. NTIS $3.50.

The atom-bombardment program was evolved through five successive versions designed for complete cascade simulation and three successive specialized versions designed for primary radiation particle (PRP) trajectory simulation. The 4-MeV iron atom bombardment of gamma-iron study was based on an ensemble of ten 4-MeV primary particle trajectory simulations and a complete study of low-energy cascades (less than 50 keV). A few simulations for higher energies indicated that the results of the low-energy study could be extrapolated to 100 keV. (MCW)

21979 HYDROGEN PERMEABILITY OF POLY- AND MONOCRYSTALS OF MOLYBDENUM AND TUNGSTEN. Zakharov, A. P.; Sharapov, V. M.; Evko, E. I. (Inst. of Physical Chemistry, Moscow). Fiz.-Khim. Mekh. Mater.; 9: No. 2, 29-33(1973). (In Russian).

In high-vacuum installations with a mass spectrometer for measurement of diffusing gases, the coefficients of permeability and diffusion for hydrogen into Mo and W were determined. Relations describing these processes in the temperature range from 400 to 1200°C and hydrogen pressures from 1 to 200 torr were obtained. It was shown that, in proportion to the increase of the size of the grain, the hydrogen permeability coefficients for polycrystals are gradually reduced and approach values observed in monocrystals. The energy of activation for the process during this is practically unchanged. (tr-auth)

21980 BEHAVIOR OF METALS AND ALLOYS IN THE MICROYIELD RANGE. Khenkin, M. L.; Abramov, V. I.; Lokshin, I. Kh. Fiz.-Khim. Mekh. Mater.; 9: No. 2, 33-36(1973). (In Russian).

The dependence on the load of the residual microdeformation in the interval from 10^{-7} to 10^{-5}, which characterizes the resistance of materials to wear and fatigue rupture as well as the dimensional stability with time, was determined. The behavior of industrial metals and alloys in the microyield range was found as a function of their structural state. The possibility of the extrapolation of the relation $\sigma - \epsilon_{res}$ in order to obtain the relative threshold of elasticity was examined. (tr-auth)

21981 PARTITIONING OF REFRACTORY-METAL ELEMENTS IN HAFNIUM-MODIFIED CAST NICKEL-BASE SUPERALLOYS. Dahl, J. M. (Climax Molybdenum Co. of Michigan, Ann Arbor); Danesi, W. F.; Dunn, R. G. Met. Trans.; 4: No. 4, 1087-1096(Apr 1973).

Data from the electron microprobe were used to elucidate the role of hafnium in altering the microstructure of the nickel-base superalloys B-1900, Alloy 713 LC, Udimet 700, and Mar-M246. The addition of about 1.3 to 2.0% Hf to these alloys improved their strength and ductility at both room temperature and 760°C. The data indicate that hafnium partitions to the surface of the MC carbides, replacing titanium and some molybdenum and/or tungsten in the carbide. On the basis of the observed morphology and composition of the carbides, it is postulated that, primarily, hafnium modifies the solidification sequence, which a) results in the formation of discrete, uniformly distributed MC carbides, b) retards the formation of secondary carbides, and c) contributes indirectly to solid solution strengthening of the matrix. (auth)

21982 INFLUENCE OF COHERENCY STRAINS ON PRECIPITATE SHAPE IN A Fe–Ni–Ta ALLOY. Cozar, R.; Pineau, A. (Ecole des Mines, Paris). Scr. Met.; 7: No. 8, 851-854 (Aug 1973).

The effect of particle size (L) on the particle shape (e/L) was studied for a Fe–30.8 Ni–9.1 Ta (wt %) alloy aged at 750°C. Results show that e/L decreases with L and that there is a break in the curve for L > 1200 Å, the particles becoming incoherent in the electron microscope. The precipitate composition is Ni_3Ta, and the lattice parameters and misfits e_{11}^T and e_{33}^T were determined. An interfacial energy of 145 or 185 ergs/cm^2 is estimated. (DLC)

21983 MAGNETOCRYSTALLINE ANISOTROPY OF EQUIATOMIC RARE EARTH–ZINC COMPOUNDS: DyZn AND ErZn. Morin, P.; Pierre, J. (CNRS, Grenoble, France). Phys. Status Solidi (a); 17: No. 2, 479-482(16 Jun 1973).

The magnetization of single crystals of the ferromagnetic compounds DyZn and ErZn is studied in magnetic fields up to 55 kOe. The easy axis in both cases is ⟨100⟩ between 4.2°K and the ordering temperatures (139 and 20°K, respectively). The magnetic anisotropy is too large in DyZn to be evaluated below 100°K; the anisotropy constants of ErZn were evaluated between 4 and 14°K. (5 figures) (auth)

21984 QUASI-ATOMIC FINE STRUCTURE IN AUGER SPECTRA OF SOLID SILVER AND INDIUM. Bassett, P. J.; Gallon, T. E.; Matthew, J. A. D.; Prutton, M. (Univ. of York, Eng.). Surface Sci.; 35: No. 1, 63-74(Mar 1973).

From proceedings of the second symposium on surface physics; Enschede, Netherlands (21 Jun 1972).

High-resolution $M_{4,5}N_{4,5}N_{4,5}$ Auger spectra of Ag and In reveal fine structure, which may be interpreted in terms of spin–orbit splitting of the initial state and multiplet structure in the final state. Interaction between d holes in Ag is an important factor in determining the shape of the Auger spectrum, and so the Auger profile is not related in any simple way to the one-particle density of states. (20 references) (auth)

21985 PHONON DISPERSION RELATION OF HOLMIUM. Maurya, J. R.; Srivastava, R. S. (Banaras Hindu Univ., India). Lett. Nuovo Cim.; 7: No. 14, 608-610(4 Aug 1973).

The lattice dynamics of Ho was studied on the basis of a modified axially symmetric model. Phonon frequencies along symmetry directions were calculated using Sundstrom's expressions; the dispersion relations show good agreement with experiment except in the TO_{11} branch of the Σ direction, where it is 15% low. (DLC)

21986 MAGNETIC PROPERTIES, HYPERFINE INTERACTIONS, AND SPIN DYNAMICS OF RARE EARTH–BERYLLIUM INTERMETALLIC COMPOUNDS. Borsa, F. (Univ., Pavia, Italy); Olcese, G. Phys. Status Solidi (a); 17: No. 2, 631-642 (16 Jun 1973).

Measurements of lattice parameter, magnetic susceptibility, and ^{9}Be nuclear magnetic resonance and relaxation were performed in a series of rare-earth–beryllium intermetallic compounds $REBe_{13}$ (RE = La, Ce, Nd, Gd). The anomalous results in $CeBe_{13}$ can be interpreted in terms of the presence of variable concentrations of Ce^{3+} and Ce^{4+} ions in the sample with a life-

time of the order of 10^{-13} s. In $NdBe_{13}$ it is found that crystal field effects are important in the temperature range investigated and they preclude magnetic order down to 1.5°K. $GdBe_{13}$ becomes ferromagnetic at about 22°K but the magnetic susceptibility is anomalous below about 100°K. Both in $NdBe_{13}$ and $GdBe_{13}$ the ^9Be asymmetric NMR spectrum at high temperature can be explained by considering only the magnetic dipolar interaction of the nuclei with the paramagnetic moments while the isotropic part of the shift is small and negative. From the ^9Be spin–lattice relaxation at high temperature reasonable values for the electronic exchange coupling parameter are obtained. (11 figures) (auth)

21987 POSSIBLE INFLUENCE OF 3d STATES ON STABILITY OF RARE EARTH-RICH RARE EARTH–TRANSITION METAL COMPOUNDS. Poldy, C. A.; Taylor, K. N. R. (Univ. of Durham, Eng.). Phys. Status Solidi (a); 18: No. 1, 123-128(16 Jul 1973).

An attempt was made to account for the existence of the crystallographic phases observed in the rare earth–transition metal phase diagram. The location of the Fermi level relative to the top of the 3d band was estimated using the magnetic properties of these materials, and a strong correlation was found between its position and the existence of a particular compound. Specifically the A_3B and AB phases exist only for E_f above the 3d states, while the A_4B_3 and possibly the AB_2 structure require the Fermi level to intersect the 3d band. (auth)

21988 DETAILED INVESTIGATION OF SLIP LINE PATTERN AND SUBSURFACE DISLOCATION STRUCTURE OF MOLYBDENUM SINGLE CRYSTALS. Luft, A.; Kaun, L. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Phys. Status Solidi (a); 18: No. 1, 109-122(16 Jul 1973).

The slip line pattern and the active slip systems at the top face of [941] and [110] molybdenum single crystals deformed in tension at room temperature are investigated by optical microscopy, surface-replica, and surface-transmission electron microscopy. The latter technique allows one to observe simultaneously slip traces and subsurface dislocation structure. Optical microscopy is shown to be insufficient for the characterization of the slip line pattern. The applicability of surface slip traces to obtain information on the activity and slip geometry of dislocations in the bulk crystals is critically discussed. (8 figures, 32 references) (auth)

21989 STUDY OF DISSOCIATED ANTIPHASE BOUNDARIES IN Ni_3Mo. van Tendeloo, G. (Rijksuniversitair Centrum, Antwerp); Delavignette, P.; Gevers, R.; Smelinckx, S. Phys. Status Solidi (a); 18: No. 1, 85-97(16 Jul 1973).

The behavior of nonconservative antiphase boundaries in the intermetallic alloy Ni_3Mo was examined by means of electron microscopy and electron diffraction. The new concept of "dissociated antiphase boundaries" was worked out in detail. From structural considerations, a model for the splitting of antiphase boundaries was proposed. The predictions for the fault planes, displacement vector, and Burgers vector of the attached dislocation were completely confirmed by the observations. It was found that growth antiphase boundaries were roughly parallel to the (100) plane and that almost all antiphase boundaries possessed a displacement vector of $\frac{1}{4}[\bar{1}02]$. The Burgers vector of the dislocation present at the splitting center was in agreement with the observed displacement vectors. (11 figures) (auth)

21990 CRITICAL-VOLTAGE ANALYSIS OF PRECIPITATION IN CERTAIN NICKEL-BASE ALLOYS. Butler, E. P. (Imperial Coll. of Science and Tech., London). Phys. Status Solidi (a); 18: No. 1, 71-83(16 Jul 1973).

The critical voltage for zero second-order reflection in quenched (single-phase) binary nickel alloys containing Au, Ta, Pt, Nb, Al, and Be was determined in the AEI EM7 high-voltage electron microscope. For the {400} reflection, Au and Ta cause a significant decrease of ≈10 kV per 1% addition. The resultant calibration curves were used to follow the compositional changes of the nickel-rich phase produced by ageing, and in the Ni–Ta alloy the critical voltage measurements show that compositional gradients exist around the precipitate particles. (8 figures, 21 references) (auth)

21991 MAGNETOCRYSTALLINE ANISOTROPY AND EFFECT OF APPLIED FIELD ON THE SINUSOIDAL MAGNETIC STRUCTURES OF $TbZn_2$ AND $HoZn_2$. Debray, D. (CEN de Saclay, Gif-sur Yvette, France). Phys. Status Solidi (a); 18: No. 1, 227-234 (16 Jul 1973).

The effect of applied field on the sinusoidal magnetic structures of $HoZn_2$ (at 4.2°K) and $TbZn_2$ (at 62.4°K) was studied by powder neutron diffraction measurements for the case when the field is perpendicular to the magnetic moment vectors. A simple theory is developed and found to predict correctly the variation of satellite intensities for low values of the applied field. Analysis of the experimental data by this theory yields the following values for the magnetic anisotropy coefficients: $K_2^0 = 5.9 \times 10^{-17}$ erg/Ho, 4.7×10^{-17} erg/Tb; $K_2^2 = 11.8 \times 10^{-17}$ erg/Ho, 8.2×10^{-17} erg/Tb, where K_2^0 and K_2^2 correspond to the L = 2, M = 0,2 coefficients in the anisotropy energy expression. There are definite indications of a metamagnetic transition at an applied field of about 15 kOe. Magnetization measurements seem to be in agreement with these results. A curious feature is the failure of some of the satellite intensities to return to original values when the field is switched off. (auth)

21992 SIMPLE CUBIC STRUCTURE IN Tb–Te FILMS. Chander, R.; Kumar, R.; Sharma, B. B. (Solid State Physics Lab., Delhi). Phys. Status Solidi (a); 17: No. 2, K157-K160 (16 Jun 1973).

When Tb was simultaneously evaporated with Te on NaCl substrates at 100°C, the composite films showed a simple cubic structure (a = 3.1465 Å) rather than the expected fcc structure. Te films deposited alone on NaCl substrates (5.6404 Å) at RT are fcc with a = 5.6408 Å, but Te deposited on KBr (6.58 Å) gives x-ray lines belonging to bulk Te. Comments on the formation of the simple cubic lattice are given. (DLC)

21993 DIFFUSION OF HYDROGEN AND DEUTERIUM IN Ta, Nb, AND V. Boes, N.; Zuechner, H. (Univ., Muenster, Ger.). Phys. Status Solidi (a); 17: No. 2, K111-K114(16 Jun 1973).

Surface impedances were removed from Ta, Nb, and V by outgassing in ultrahigh vacuum and protecting the clean samples with vapor-deposited Pt films. Diffusion coefficients were measured at 25°C using the electrochemical pulse method. The effect of thickness was studied in detail for Ta; extrapolation was made to infinite thickness and vanishing H isotope content. (DLC)

21994 EFFECT OF SPECIMEN THICKNESS ON THE FRACTURE SURFACE ENERGY OF (100) AXIS TUNGSTEN SINGLE CRYSTALS. Cordwell, J. E.; Hull, D. (Univ. of Liverpool). Phil. Mag.; 27: No. 5, 1183-1192(May 1973).

The fracture surface energy has been determined on sheet crystals with a single-edge crack normal to the tensile axis. The crystals were precracked at 77°K using a spark discharge technique and tested immediately at the same temperature. The thickness of the crystals was varied between 94 and 670 μm. The shape of the spark crack varied with specimen thickness and crack length. The fracture surface energy was approximately constant at about 1.7 J/m² for specimen thicknesses above 400 μm. For thicknesses below this value the fracture surface energy increased rapidly to 30 J/m² for a specimen thickness of about 200 μm. This increase is attributed to a changeover from plane strain to plane stress fracture. The specimen thickness also affected the plane on which crack propagation occurred. In thick specimens the initial (100) spark crack continued to propagate on the (100) plane. As the specimen thickness decreased there was an increasing tendency for initial propagation to occur on planes close to (110). (auth)

21995 EFFECT OF MAGNETIC FIELDS ON ELECTRIC AND THERMAL RESISTANCE OF THULIUM. Janos, S. (Safarik Univ., Kosice, Czech.). Phys. Status Solidi (a); 18: No. 1, K9-K10(16 Jul 1973).

Effects of magnetic fields up to 23 kOe were studied at 1.5 and 4.5°K. While the electric magnetoresistance of Tm showed a simple behavior with a max at 5 kOe (1.5°K) or 8 kOe (4.5°K), the thermal magnetoresistance had a max at 14 kOe and a min at 18 kOe. The temperature dependences of the thermal conductivity in 0 and 23 kOe fields are similar. (DLC)

21996 ELECTRONIC PROPERTIES OF METALS AND ALLOYS. Summer School on Physical Metallurgy, Royan, France, September 13, 1971. Janot, C.; Gerl, M.; Grilhe, J.; Caisso, J. (comps.). Paris; Masson (1973). 530p. (In French).

Five texts have been abstracted for NSA. They deal with superconductivity, resistivity and specific heat, diffraction and scattering of neutrons, NMR in metals and alloys, and studies of metals and alloys using the Moessbauer effect. (FR)

For abstracts of individual chapters see: 21997–22000, and 22696.

21997 TWO BASIC EXPERIMENTAL TECHNIQUES: RESISTIVITY AND SPECIFIC HEAT. Quere, Y. (CEN, Fontenay-aux-Roses, France). pp 407-434 of Electronic Properties of Metals and Alloys. Janot, C. (comp.). Paris; Masson (1973). (In French).

From summer school of physical metallurgy; Royan, France (13 Sep 1971).

The techniques used to measure electrical resistivity and their applications are presented: lattice temperature measurements, electrical conductivity measurements, crystal defect measurements, phase transformation studies. In addition, the techniques used to measure specific heat and their applications are also

studied: Debye temperature measurements, density of state measurements, magnetic properties, and Schottky anomalies. (FR)

21998 NEUTRON-DIFFRACTION AND SCATTERING STUDIES. Meriel, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 435-451 of Electronic Properties of Metals and Alloys. Janot, C. (comp.). Paris; Masson (1973). (In French).

From summer school of physical metallurgy; Royan, France (13 Sep 1971).

A definition is given of the neutron-diffraction phenomenon in matter (nuclear and magnetic origin) correlated with magnetic and nuclear scattering amplitudes. Applications of polarized neutrons to the study of magnetic alloys are reviewed. (FR)

21999 NUCLEAR MAGNETIC RESONANCE AND THE ELECTRONIC STRUCTURE OF METALS AND ALLOYS. Minier, M. (Univ., Grenoble, France). pp 453-473 of Electronic Properties of Metals and Alloys. Janot, C. (comp.). Paris; Masson (1973). (In French).

From summer school of physical metallurgy; Royan, France (13 Sep 1971).

The principles of the NMR technique are recalled together with the parameter that it enables to be measured. An application to self-diffusion is given and simple cases with metals and alloys are studied. (FR)

22000 STUDY OF ELECTRONIC PROPERTIES OF METALS AND ALLOYS USING THE MOESSBAUER EFFECT. Janot, C. (Ecole Nationale Superieure, Nancy). pp 475-507 of Electronic Properties of Metals and Alloys. Janot, C. (comp.). Paris; Masson (1973). (In French).

From summer school of physical metallurgy; Royan, France (13 Sep 1971).

The principle of Moessbauer effect spectroscopy with examples are used to establish the relation between Moessbauer parameters and electronic properties: variation of the isomeric shift with the electron density and the filling up of bands; studies of the magnetic couplings; spin interaction range; electronic interpretation of magnetic properties. Only the case of Fe is developed as an example. (FR)

22001 ELECTRICAL CONDUCTIVITY OF SODIUM VAPOUR. Morrow, R.; Craggs, J. D. (Univ. of Liverpool). J. Phys., D (London); 6: No. 10, 1274-1282(29 Jun 1973).

The electrical conductivity of near-saturated sodium vapour was measured in a coaxial-cylinder two-electrode system at about 1100 to 1500 K. The results support the conductivities calculated by Robbins and his collaborators (Adv. Phys.; 16: 739-43 (1967)) on the basis of the $Na/Na_2/Na_4$ vapour model. (auth)

22002 DILUTE ALLOYS. Mezei, F.; Radhakrishna, P. (Institut Max von Laue-Paul Langevin, Grenoble, France). Ann. Phys. (Paris); 7: No. 4, 269-286(Jul 1972).

A general theoretical discussion on the scattering of polarized neutrons by impurities is presented. A survey is then given of the available experimental results and their physical significance (static and dynamic behavior of impurities in powerful magnetic systems, or of impurities with very large moments). A description is then given of some possible future applications of neutron scattering to the study of impurity problems (Kondo effect, spin fluctuations, and other inelastic phenomena). (FR)

22003 MAGNETIC NEUTRON SCATTERING IN RELATION TO SOME OTHER EXPERIMENTAL METHODS. Moessbauer, R. L. (Institut Max von Laue-Paul Langevin, Grenoble, France). Ann. Phys. (Paris); 7: No. 4, 287-298(Jul 1972).

The magnetic properties of matter can be studied by a variety of experimental methods, the different techniques often providing complementary information. Three applications in which the magnetic scattering of neutrons and other techniques provide complementary information are presented: the use of polarized gamma radiation for spin-structure determinations, possible applications of neutrons to the study of hyperfine magnetic interactions, studies of spin-waves using neutrons and electromagnetic waves. (tr-auth)

22004 HEAT CAPACITY BEHAVIOUR OF Pu-Fe EUTECTIC ALLOY (10 a/o Fe) BETWEEN 15 AND 373°K. Evidence for Order-Disorder and an Antiphase Structure Below Room Temperature. Sandenaw, T. A.; Harbur, D. R. (Los Alamos Scientific Lab., NM). Int. J. Theor. Phys.; 34: No. 9, 1487-1495(Sep 1973).

Low-temperature heat-capacity studies of Pu-Fe eutectic alloy have suggested the possibility of order-disorder of atoms and an antiphase structure below room temperature. Slow cooling and temperature cycling below 76°K were required for appearance of the postulated antiphase structure. Fermi surface-Brillouin zone boundary interactions are suggested as an explanation for the low-temperature behaviour of the eutectic alloy as well as for the resistivity maximum in both Pu_6Fe and α-Pu. The best values for $S^0(298)$ and $[H^0(298) - H^0(0)]$ were judged to be 14.20 ± 0.10 cal mol^{-1} K^{-1} and 1660 ± 30 cal mol^{-1}. (auth)

22005 VARIOUS TYPES OF PRESSURE VESSELS AND PROPERTIES OF STEELS USED. Neuhaus, W. (Thyssen AG, Oberhausen, Ger.). (1972). vp. (In German).

From meeting on the metallurgy of iron; Duesseldorf, Germany (9 Nov 1972).

Information is presented on design of pressure vessels, examples of different types of pressure vessels, forces acting on pressure vessels, mechanical properties of pressure vessel steels, influence of cold working and stress annealing on steel mechanical properties, anisotropy in steels testing methods for reactor materials, change of material properties by operating conditions, problems of steel selection, and establishment of specifications. (GE)

22006 MAGNETISM OF THE RARE EARTH METALS. Lemaire, R.; Pierre, J. (CNRS, Grenoble, France). Rev. Chim. Miner.; 10: No. 1, 273-290(1973). (In French).

An overall view is given of the magnetic properties of rare earth metals. The properties of the free ions and the effect of the crystalline field on the paramagnetic susceptibility and on the momentum directions in the ordered state are discussed. Long range indirect magnetic interactions are responsible for the ordered helical magnetic and modulated structures. (FR)

22007 RECRYSTALLIZATION TEXTURE OF TUNGSTEN SHEETS. Koerner, W. (Univ., Marburg, Ger.). Z. Metallk.; 64: No. 7, 509-510(1973). (In German).

A new texture of annealed, rolled tungsten is reported, the symmetry properties of which deviate from the symmetry of the known textures. Possible reasons for the result are discussed, and the importance of the deformation and recrystallization process in the near-surface layers is emphasized. (GE)

22008 DETERMINATION OF THE PHASE DIAGRAM OF THE MOLYBDENUM-NICKEL SYSTEM USING DIFFUSION COUPLES AND EQUILIBRATED ALLOYS. Heijwegen, C. P.; Rieck, G. D. (Technische Hogeschool, Eindhoven, Netherlands). Z. Metallk.; 64: No. 6, 450-453(1973).

The phase diagram of the molybdenum-nickel system between 800 and 1,295°C was investigated by both microscopic and electron probe micro-analysis. Equilibrated two-phase molybdenum-nickel alloys, as well as diffusion couples consisting of the pure metals or their alloys, were used in order to compare both methods. In both cases, identical phase diagrams are found that differ in details from the phase diagram given by Casselton and Hume-Rothery. The homogeneity range of the δ-MoNi phase extends from 47.8 to 51.8 at. % Ni. The solubility limit of molybdenum in nickel is 28 at. % Mo at 1,318°C, decreasing with temperature by 2.3 at. %/100°C. The homogeneity region of the γ-$MoNi_3$ phase is situated at compositions higher than 75 at. % Ni. It was not possible to determine its boundary concentrations exactly, as is also the case for the β-$MoNi_4$ phase. The solubility of nickel in molybdenum is very small, being about 2 at. % Ni at 1,295°C. (GE)

22009 PHASE DIAGRAM OF THE TERNARY SYSTEM Mo-Zr-Cr. Eremenko, V. N.; Prima, S. B.; Tret'yachenko, L. A. (Inst. of Problems in Materials, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 6, 554-558(Jun 1973). (In Ukrainian).

Cast annealed and hardened samples of the ternary system Mo-Zr-Cr were studied by metallographic and x-ray analysis and the temperatures of alloy melting beginning were determined by the Pirani-Altertum method. The results permitted the character of phase equilibria in the ternary system to be established and a number of isothermal and polythermal sections and projections of solidus and liquidus to the concentration triangle plane to be presented. It is found that, in the ternary system at ≈1850°C, there occurs a nonvariant four-phase transformation of twice-peritectic type $L + \alpha + \gamma \rightleftharpoons \delta$, where the metal solid solutions (α) on the base of Mo and Cr and solid solutions of metallides Zr $(Mo, Cr)_2$ with cubic (γ) and hexagonal (δ) structures are in equilibrium with liquid. (auth)

22010 NEW REPRESENTATIVES OF $MgCuAl_2$ AND $YNiAl_4$ STRUCTURAL TYPES. Rikhal, R. M.; Zarechnyuk, O. S.; Pishchik, A. V. (Lvov State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 6, 568-570(Jun 1973). (In Ukrainian).

The alloys of the compositions $RCoAl_2$, $RNiAl_2$, $RCuAl_2$, $RCoAl_4$ and $RNiAl_4$ (where R is a rare-earth metal) were studied by the method of x-ray analysis to establish compounds belonging to the $MgCuAl_2$ and $YNiAl_4$ structural types. It was established that the components with the $MgCuAl_2$ type structure are formed in the

systems Y–Co–Al and R–Ni–Al (where R = Gd, Tb, Dy, Ho, Er, Tm) and compounds with the $YNiAl_4$ types structure in the systems R–Ni–Al (where R = Tb, Dy, Ho, Er, Tm, Lu). The other alloys were either heterogeneous or compounds with an unknown structure. (auth)

22011 CRYSTALLINE FINE STRUCTURE OF ELECTRODEPOSITED RHENIUM. Vartanova, G. A.; Surov, Yu. I. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 1, 66-67(Jan 1973).
Translated from Zh. Fiz. Khim.; 47: No. 1, 121-123(Jan 1973).

The crystalline fine structure of rhenium, electrodeposited in the presence and in the absence of an ultrasonic field, was studied by x-ray diffraction. The structure is pseudocrystalline in character. Determinations have been made of the grain size and of the relative size of the microdeformation, whose appearance is attributed to nonuniform distribution of hydrogen in the rhenium deposit. Smaller values for both parameters are obtained in rhenium deposited in an ultrasonic field. When the grains are annealed, the "sonicated" specimens grow more rapidly. (auth)

22012 SIMULATION OF POSITRON CHANNELING IN SINGLE CRYSTALS. Kudrin, V. V.; Timoshnikov, Yu. A.; Vorobev, S. A. (Tomsk Polytechnical Inst., USSR). Phys. Status Solidi (b); 58: No. 1, 409-414(1 Jul 1973).

A simulation method of charged particle scattering in a crystal lattice is described. Angular distributions of protons and positrons leaving the crystal are calculated and the orientational distributions of axial channeling particles are received. The influence of the experimental geometry and the crystal condition on the obtained results is discussed. It is shown that binary collision calculation gives agreement with experimental results. (auth)

22013 STRUKTURA V OB'EME I NA POVERKHNOSTI PROKATANNYKH MATERIALOV. (Structure in Volume and on Surface of Rolled Materials). Severdenko, V. P.; Gurskii, L. I. Minsk; Nauka I Tekhnika Press (1972). 308p.

Information is presented on the flow of a metal at the deformation center in various rolling and plastic deformation modes, using ultrasound. It is demonstrated that the structure and properties result not only from the degree of deformation, but also significantly from the modes of deformation and conditions at the contact surface. The texture, dislocation structure, microdistortions of the lattice, blocks of the mosaic, and residual stresses of first and second kind during deformation and annealing in the volume and on the surface of compact and powdered materials are studied. The stress and strain state during rolling of three-layer packets is analyzed. The peculiarities of the interaction of dislocations with the free surface and boundaries in the metal are studied. Methods are suggested for calculation of lattice defects. Particular attention is given to investigation of the structure of the surface layers of plastically deformed materials and the structures of powder materials. (auth)

22014 EFFECT OF COLD WORKING ON CREEP PROPERTIES OF 316 STAINLESS STEEL USED AS A FUEL CLADDING IN FAST BREEDER REACTORS. Furuta, T.; Ogawa, Y.; Nagasaki, R. (Japan Atomic Energy Research Inst., Tokai). Tetsu To Hagane; 59: No. 7, 949-954(Jun 1973). (In Japanese).

The effect of cold working on creep properties of 316 stainless steel used for a fuel-cladding material in the fast breeder reactor was investigated. Specimens rolled by 0 to 30% were tested under various stresses, 4 to 15 kg/mm², at 650 and 750°C. It was observed that the 5% cold-rolled specimen showed the minimum creep rate under low stress at 650°C, however, the non-cold-rolled specimen showed the lowest creep rate at 750°C. This could be explained by the creep strain which assisted the recovery of the previous strain due to cold working. The recovery observed by x-ray diffraction was a clear evidence of the above explanation, especially in the case of creep at 750°C. (auth)

22015 APPLICATION OF WEAK-BEAM IMAGING TO STUDIES OF SMALL DISLOCATIONAL LOOPS. Perrin, R. C.; Eyre, B. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Microscopy; 98: No. 2, 200-208(Jul 1973).
From EMCON symposium on applications of the weak beam technique in materials science; Manchester, England (12 Sep 1972).

Coupled differential equations for calculating diffracted and transmitted intensities from thin crystals were solved numerically for many beam diffracting conditions. This approach was used to study weak-beam dark-field images from small circular edge dislocation loops. The exact displacement field around such loops was calculated using isotropic elasticity theory. Crystal orientations were chosen to obtain single systematic rows of low order reflections and loop images were calculated for different combinations of strong and weak beams. Although emphasis was placed on investigating the application of weak beam imaging to determine the nature of small loops (dia <10 nm) a preliminary study was also made of $\mathbf{g} \cdot \mathbf{b} = 0$ residual images. The calculated images were compared with experimental weak beam images of small loops in neutron-irradiated molybdenum. (auth)

22016 DETERMINATION OF THE GEOMETRY AND NATURE OF SMALL FRANK LOOPS USING THE WEAK-BEAM METHOD. Jenkins, M. L.; Cockayne, D. J. H.; Whelan, H. F. (Oxford Univ.). J. Microscopy; 98: No. 2, 155-164(Jul 1973).
From EMCON symposium on applications of the weak beam technique in materials science; Manchester, England (12 Sep 1973).

Theoretical and experimental investigations were carried out to determine under which conditions weak-beam images can give useful information on the geometry, size, and nature of small Frank loops. Suitable experimental conditions for obtaining such information were deduced from computed weak-beam images of Frank loops under various selected loop and foil orientations and diffraction vectors. Experiments to check these deductions were performed in silicon damaged by irradiation with phosphorus ions. It was found that the geometry and size of loops of diameter $\gtrsim 8$ nm (80 Å) viewed normal to their habit plane was well defined by weak-beam images taken in $\{220\}$ reflections lying in the loop plane for which $\mathbf{g} \cdot \mathbf{b} = 0$ and $\mathbf{g} \cdot \mathbf{b} \times \mathbf{u} \neq 0$. By imaging in reflections with $\mathbf{g}$ vectors not in the loop plane the enclosed stacking faults were imaged (thus confirming the loops to be Frank loops) and the sense of the Burgers vector (i.e., the loop nature) was determined. (auth)

22017 ELECTRONIC STRUCTURE OF α-CERIUM FROM MAGNETIZATION DATA. Grimberg, A. J. T.; Schinkel, C. J. (Univ. of Amsterdam). Solid State Commun.; 13: No. 2, 193-196(15 Jul 1973).

The magnetic properties of α-cerium are determined. It is shown that an analysis in terms of the Stoner model and a Lorentzian 4f-peak in the density of states can be made consistent in a two-band model, but not in a single-band model. (auth)

22018 SHRINKAGE IN SINTERING OF POROUS TANTALUM POWDER COMPACTS. Lee, D. N. J. Korean Inst. Metals; 10: No. 4, 257-265(1972).

A formula describing the progress of shrinkage of a powder compact was derived for the case of sintering of nonspherical particles as follows: $f = \text{constant}\ (t/T)^m \exp[-mQv/(RT)]$. Here f is the ratio of change in a linear dimension of a powder compact during sintering to the original dimension, and t, T, R, Q, and m are the sintering time, the sintering temperature on the absolute scale, the gas constant, the activation energy for the volume diffusion, and the geometric factor, respectively. The shrinkage of tantalum powder compact composed of powders with the various shapes was analyzed, based on the formula. The activation energy for the volume diffusion of tantalum was evaluated to be about 80,000 cal per mole. (Korean Sci. Abstr.)

22019 SINGLE-IMPURITY EFFECT ON THE ELECTRON–HOLE T MATRIX IN GADOLINIUM. Holz, A. (Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil). Phys. Status Solidi (b); 58: No. 1, 237-242(1 Jul 1973).

An interpretation of the large 15 $\mu\Omega$cm per at. % residual electrical resistivity of Mg in a Gd host is suggested in terms of the formation of bound interband electron–hole states at the Mg site. The theory is developed for a single Mg ion in a Gd host and allows a qualitatively correct interpretation of the experiments. According to an order-of-magnitude estimate, an instability of the paramagnetic ground state in the presence of a single Mg ion seems to be possible when band structure effects on the screening of the Coulomb interaction are taken qualitatively into account. (auth)

22020 LATTICE ABSORPTION OF SOUND IN InSb AT 77°K. Ilisavskii, Y. V.; Chiplis, D. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 14: No. 8, 2085-2088 (Feb 1973).

The lattice absorption of an acoustic wave propagating along [110] and polarized along [001] is measured in pure samples of n-InSb at 77°K in the frequency range 0.5–3.0 GHz. We first observed with increasing acoustic frequency a transition from a quadratic frequency dependence of absorption to a linear dependence. The experimental results agree with Akhiezer's theory for $\omega\tau_{ph} < 1$ and with the Landau–Rumer theory for $\omega\tau_{ph} > 1$. (auth)

22021 NUCLEAR MAGNETIC RESONANCE IN NbAl ALLOYS. Hernaandez, R. J. (Continental Can Company, Chicago, Illinois 60620); Van Ostenburg, D. O. Phys. Rev. B 7: No. 3, 1199-1201 (1 Feb 1973).

Measurements of the Knight shift of Nb^{93} were made for Nb–Al alloys in the body-centered-cubic solid-solution region up to 8-at.% Al in Nb and in the two-phase region at 14-at.% Al. In the solid solution, the Knight shift decreases from 0.845% in pure Nb to 0.780% at 8-at.% Al. In the two-phase region made up of Nb and Nb_3Al, the Knight shift is 0.805%. The decrease in the shift vs Al content is tentatively interpreted according to the rigid-band model. This is in

contrast to previous work in V–Al and V–Ga systems where the rigid–band model is not believed to apply. (auth)

22022 COMPTON PROFILE OF SINGLE–CRYSTAL VANADIUM. Phillips, W. C. (Physics Department, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. B 7: No. 3, 1047-1052 (1 Feb 1973).

The Compton profile of single–crystal vanadium has been measured with Mo Kα x rays. The observed profile shows that the V band electrons are more spatially extended than the density calculated from Hartree–Fock V 3d functions. The measured anisotropy in the profile is significantly less than that calculated for free–atom 3d functions with an orbital population of 80% t_{2g}. (auth)

22023 METALLOGRAPHIC STUDY OF SEGREGATION IN URANIUM–BASE–NIOBIUM ALLOYS. Jackson, R. J. (Dow Chemical Co., Golden, CO). Metallography; 6: No. 4, 347-360 (Aug 1973).

Three types of niobium segregation are considered in uranium–base niobium alloys: dendritic coring, macrobanding, and gross–ingot segregation. The origin and nature of these inhomogeneities are discussed, as are optical and x-ray metallographic techniques for their identification. Measurements such as half-height peak widths, peak intensity ratios, hardness, and optical microstructures, are related to segregation. Finally, tests and procedures for minimizing segregation are discussed. (8 figures) (auth)

22024 SIMULTANEOUS MEASUREMENT OF SPECIFIC HEAT, ELECTRICAL RESISTIVITY, AND HEMISPHERICAL TOTAL EMITTANCE OF NIOBIUM–1 (wt.%) ZIRCONIUM ALLOY IN THE RANGE 1500 TO 2700 K BY A TRANSIENT (SUBSECOND) TECHNIQUE. Cezairliyan, A. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 77A: No. 1, 45-48(1973).

Simultaneous measurements of specific heat, electrical resistivity, and hemispherical total emittance of niobium–1 (wt.%) zirconium alloy in the temperature range 1500 to 2700°K by a subsecond–duration pulse–heating technique are described. Estimated inaccuracy of measured properties is: 3% for specific heat and hemispherical total emittance, and 0.5% for electrical resistivity. Properties of the alloy are compared with the properties of pure niobium. It was found that specific heat and emittance of the alloy were approximately 0.5% and 1.5%, respectively, higher than those of pure niobium. Electrical resistivity of the alloy was 0.5% lower than that of pure niobium. Like niobium, the alloy showed a negative departure from linearity in the curve of electrical resistivity versus temperature. (auth)

22025 HIGH–TEMPERATURE ENTHALPY AND THE ENTHALPY OF FUSION OF BORON BY DROP CALORIMETRY. Stout, N. D. (Univ. of California, Livermore); Mar, R. W.; Boo, W. O. J. High Temp. Sci.; 5: No. 4, 241-251(Aug 1973).

The high–temperature enthalpies were measured at higher temperatures (1800 to 2200°K) than by previous workers. The data, combined with earlier work at 1300–1700°K, may be represented to within ±0.57% by the equation $H^\circ - H^\circ_{298} = 4.859\ T + 6.150 \times 10^{-4}\ T^2 + 2.272 \times 10^5\ T^{-1} - 2265.1$ cal/g-atom. The enthalpy of fusion of boron was found to be 12.0 ± 0.4 kcal/g-atom, which gives an entropy of fusion of 5.1 cal/g-atom K, based on a melting point of 2350°K. The entropy of fusion is more than twice that of previous estimates and indicates that highly covalently bonded elements such as boron will have a much higher entropy of fusion than metals. (auth)

22026 ABSOLUTE VISCOSITY OF CADMIUM–TIN ALLOYS. Kanda, F. A.; Falkiewicz, M. J. (Syracuse Univ., NY). High Temp. Sci.; 5: No. 4, 252-259(Aug 1973).

The absolute viscosity of tin and some thirteen cadmium–tin alloys were measured as a function of temperature between the liquidus and 350°C by an oscillating–cup viscometer. The viscosity of pure tin ranged from 0.01684 poise at 256°C to 0.01219 poise at 442°C. The alloys ranged in composition from pure tin to 86.5 at. % cadmium. A plot of $\log \eta$ versus 1/T was linear for all samples studied. Isotherms of viscosity versus composition (34 at. % cadmium). Results obtained support the belief that liquid solutions near the eutectic composition do not possess a "quasi–eutectic" structure. (auth)

22027 MAGNETIC PROPERTIES OF HEUSLER ALLOYS CONTAINING TRANSITION METALS. Ziebeck, K. (Univ., Bonn). (1973). vp.

From spring meeting of the Deutsche Physikalische Gesellschaft; Bad Nauheim, Germany (27 Mar 1973).

To obtain information on the moment formation and interaction mechanism in the compounds Co_2TiAl, Co_2VAl, and Co_2TiGa, magnetization and diffraction measurements were made. The crystal structure is also discussed. (GE)

22028 EFFECT OF HEAT TREATMENT ON THE TENSILE STRENGTH AND HARDNESS OF A QUENCHED TERNARY ZIRCONIUM–BASE ALLOY (Zr–0.5 wt % Nb–1 wt % Cr). Mukherjee, J. L.; Ray, S.; Mehta, M. L. (Bhabha Atomic Research Centre, Bombay). J. Less–Common Metals; 32: No. 2, 189-197(Aug 1973).

The response of a ternary zirconium–base alloy, Zr–0.5 wt % Nb–1 wt % Cr, to hardening by thermal treatment was investigated. A marked increase in the strength of the alloy was observed when it transformed to a martensitic structure after rapid cooling from the high–temperature phase field, $\alpha + \beta$ or β. The structure of the as–quenched martensite was found to be hexagonal close–packed and it was supersaturated with respect to the solute elements (Cr and Nb). Tempering of this structure in the temperature range 400 to 700°C lowered the hardness, an appreciable decrease being observed on tempering above 500°C. Factors responsible for the high strength of the as–quenched martensite are suggested. (auth)

22029 THERMODYNAMIC PROPERTIES OF THE MERCURY–INDIUM SYSTEM. Singh, H. P.; Misra, S. (Banaras Hindu Univ., India). J. Less–Common Metals; 32: No. 2, 227-235(Aug 1973).

The heats of formation at 81°K of several solid Hg–In phases, namely, the intermediate phases $Hg_{89}In_{11}$, Hg_6In, Hg_5In, HgIn, $HgIn_2$, and indium–based α–cubic and α–tetragonal terminal solid solutions were determined in a liquid alloy solution calorimeter. The free energies of formation of the congruently melting phases Hg_6In and HgIn and the excess free energies of the corresponding liquid alloys were calculated by Wagner's analysis. The entropies of formation of solid Hg_6In and HgIn were derived from the experimental values of their heats of formation and the calculated values of their free energies of formation. Results are discussed in terms of the relative stabilities and constitution of these phases. (26 references) (auth)

22030 PHASE TRANSITIONS IN SUPERCONDUCTING ALLOYS OF THE Nb–Ti–Zr SYSTEM. Kadykova, G. N. Tr., Mosk. Inst. Elektron. Mashinostr.; No. 22, 10-20(1972). (In Russian).

It is shown that decay occurs of the metastable β–solid solution with the formation of ω and α phases in the cold–deformed alloy of titanium containing 35 wt % Nb and small admixtures of zirconium during isothermal annealing and heating. During the annealing and heating of 50 to 65% niobium–containing alloys, a change takes place in their physical properties showing the decay of the metastable beta–solid solution with the formation of fine–dispersion alpha–phases. (JPRS)

22031 INFLUENCE OF ULTRASOUND ON DISLOCATIONAL STRUCTURE AND MECHANICAL PROPERTIES OF MOLYBDENUM. Kovsh, S. V.; Kotko, V. A.; Polotskii, I. G.; Prokopenko, G. I.; Trefilov, V. I.; Firstov, S. A. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 35: No. 6, 1199-1205(1973). (In Russian).

A method for the ultrasonic irradiation of metals in vacuum at increased temperature on drawn out and bent Mo was developed. Under the effect of ultrasonics, a slightly disoriented (up to 1°) cellular structure is formed, and an increase of the strength characteristics was observed. It was established that in the ultrasonic–irradiated Mo, a high density of the dislocated lattice, particularly at the grain boundaries and cell boundaries, takes place. (tr–auth)

22032 KINETICS OF ELECTRICAL RESISTANCE VARIATION DURING ANNEALING OF COLD–WORKED BERYLLIUM. Papirov, I. I.; Stoev, P. I.; Taranenko, I. A. (Physical–Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 6, 1241-1247(1973). (In Russian).

The process of recovery of the electrical resistance of Be (99.9%), rolled at a temperature of 400°C with reductions of 30, 70, and 90%, was studied. A kinetic equation was proposed for recovery of the electrical resistance, which can be used for the evaluation of the peak value of the internal stress. Anomalies detected in the recovery were associated with the complex character of the structure of the cold–worked metal. (tr–auth)

22033 INFLUENCE OF PLASTIC DEFORMATION EXTENT ON STRUCTURE AND MECHANICAL PROPERTIES OF LOW–ALLOYED MOLYBDENUM. Vitorskii, Ya. M.; Ivashchenko, R. K.; Kaverina, S. N.; Lotsko, D. V.; Mil'man, Yu. V.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 35: No. 5, 1064-1074(1973). (In Russian).

The change in structure and mechanical properties during increase of the degree of deformation of rolling was studied on low–alloyed Mo. An estimation was made of the critical disorientation of the dislocated cell during which its boundaries begin to fulfill the roll of grain boundary. It was found that the boundaries of the cells can be effective barriers for the propagation of fractures. (tr–auth)

22034 DEFECT STRUCTURE OF NIOBIUM SINGLE CRYSTALS DEFORMED BY ROLLING AT 77°K. Gindin, I. A.; Aksenov, V. K.; Matsevityi, V. M.; Starodubov, Ya. D. (Physical Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 5, 1084-1090 (1973). (In Russian).

By the methods of electron microscopy, electric resistance, and microhardness, monocrystals of Nb, rolled at 77°K with two different orientations, (001) [110] and (112) [20$\bar{1}$], were investigated. It was found that the change of the defect structure of the monocrystals takes place primarily in the initial stages of deformation (up to $\delta = 20\%$) and that at large deformations a dynamic equilibrium is established between processes of reinforcement and softening. Rolling of the monocrystals (112) [20$\bar{1}$] exerts a more turbulent flow than in the case of (001) [110] orientation, which specifies a greater inclination of the structure to recrystallization. Softening of the monocrystals (112) [20$\bar{1}$] occurred during annealing in the in-site recrystallization stage. [tr-auth]

22035 CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF $SmCO_5$ POWDERS. Ul'yanov, A. N.; Deryagin, A. V.; Michin, D. D. (Ural State Univ., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 35: No. 5, 1094-1096(1973). (In Russian).

Results of the study of the crystalline structure and magnetic properties of powders obtained by mechanical grinding of $SmCo_5$ in a vibration mill in toluol were reported. Experimentally it was established that, for coarse powders, anomalous broadening of the x-ray structural lines was observed. The magnetization curves of the isotropic powders for different grinding times were obtained by mechanical grinding of the ingot cooled from temperatures higher than the Curie point. (JSR)

22036 MAGNETIC PROPERTIES OF THORIUM–DYSPROSIUM ALLOYS. Chechernikov, V. I.; Chechkhiani, Z. B.; Shavishvili, T. M.; Slovyanskikh, V. K. (Moscow State Univ.). Fiz. Metal. Metalloved.; 35: No. 5, 1105-1106(1973). (In Russian).

The magnetic properties of Th–Dy alloys containing 1, 2, 3, 4, 5, 15, 20, 25, 30, and 34 at. % Dy were measured. The magnetic susceptibility of all alloys in the temperature interval from 78 to 700°K follows the Curie–Weiss law, whereas the value of the effective magnetic moment for the Dy atom corresponds to the moment of the isolated trivalent ions in the $^5I_8$ state. At room temperature, the magnetic susceptibility monotonously increases with the increase of the Dy concentration. (JSR)

22037 INFLUENCE OF ZIRCONIUM CONCENTRATION ON CREEP OF NIOBIUM–ZIRCONIUM ALLOYS. Prokoshkin, D. A.; Vasil'eva, E. V.; Tret'yakov, V. I. (Moscow Higher Technical School). Fiz. Metal. Metalloved.; 35: No. 5, 1045-1051(1973). (In Russian).

The creep of the binary alloy Nb–Zr was investigated at Zr concentrations of 1, 5, 10, and 20 wt.%. The concentration dependences of the rate and activation energy of these characteristics on the stationary part were plotted. A high resistance to creep of Nb–1% Zr was observed. Calculations showed that, at this concentration of Zr under the conditions studied, saturation of the defect site of the lattice with the alloying element occurs. Increase of the concentration of Zr in the alloy leads to regular decrease of thermal stability which is determined by increase of the concentration of an element having a much lower melting temperature than Nb and, consequently, a much higher diffusion mobility. (tr-auth)

22038 STUDY OF OXYGEN DIFFUSION IN ZIRCONIUM BY THE $^{18}O(p,\alpha)^{15}N$ NUCLEAR REACTION. Feborov, G. B.; Skakun, N. A.; Khar'kov, O. N.; Fetisov, G. V.; Kissil, A. E. (Moscow Engineering Physics Inst.). Fiz. Metal. Metalloved.; 35: No. 5, 978-981(1973). (In Russian).

By means of the resonance of the $^{18}O(p,\alpha)^{15}N$ nuclear reaction at $E_p = 629$ keV and the method of layer removal, the diffusion characteristics of oxygen in α–Zr was measured in the temperature interval from 550 to 835°C. Results are compared with literature data. (tr-auth)

22039 MODIFIED GREEN FUNCTION TECHNIQUE FOR THE CALCULATION OF LATTICE DISTORTION SURROUNDING INTERSTITIALS. Benedek, R.; Ho, P. S. (Cornell Univ., Ithaca, NY). J. Phys., F (London); 3: No. 7, 1285-1295(Jul 1973).

The Green function technique for the calculation of lattice distortion surrounding point defects is modified to enable the treatment of interstitial defects. The modification consists in treating a selected region immediately surrounding the interstitial formally as a cluster of n + 1 interstitials and n vacancies. This region, called the interstitial "core," includes atoms which are displaced by large amounts from their normal lattice sites and therefore cannot be treated within the standard harmonic approximation. The method is illustrated by a calculation for the (111) split crowdion configuration in tungsten. Displacement fields are calculated for two separate interatomic potentials, one fitted to the phonon spectrum and the other to elastic constants. Predicted atomic relaxations for both potentials are quite similar. (auth)

22040 THEORY OF DEFECT SUPERLATTICES IN CRYSTALS WITH APPLICATION TO VOID/VACANCY AND NITROGEN INTERSTITIAL LATTICES IN TANTALUM AND VANADIUM. Tewary, V. K. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., F (London); 3: No. 7, 1275-1284(Jul 1973).

An elastic interaction theory is proposed for the formation of a regular array of substitutional or interstitial defects—the defect superlattice—in a crystal. A Green function method is described for the calculation of the formation energy of a defect superlattice. The theory predicts the formation of a void/vacancy lattice in tantalum and vanadium with the ratio of the void lattice constant to the void radius as eight for both the metals and a lattice of nitrogen interstitials at octahedral sites in tantalum and vanadium with the equilibrium concentration of nitrogen atoms per host atom at $1/_{64}$ in tantalum and $1/_{16}$ in vanadium. Agreement with the experimental observations where available, namely, the void lattice in tantalum and the nitrogen lattice in vanadium, is good. (auth)

22041 EFFECT OF FINITE F LEVEL LINEWIDTH ON THE THEORY OF THE $\alpha-\gamma$ TRANSITION IN Ce. Alascio, B.; Lopez, A.; Olmedo, C. F. E. (Comision Nacional de Energia Atomica, San Carlos de Barilocke, Argentina). J. Phys., F (London); 3: No. 7, 1324-1338(Jul 1973).

The Ramirez–Falicov theory of the $\alpha-\gamma$ transition in Ce was extended to include the effect of hybridization of the localized 4f states with the band. The physical properties of the α and γ phases were calculated using thermodynamic Green functions which were determined by a decoupling procedure that accounts for the highly correlated character of the f levels. The decoupling procedure was exact to second order in the hybridization parameter. Satisfactory values for the noninteger valency, electronic specific heat, and magnetic susceptibility of the α phase were found. A Curie law for the γ phase was also obtained. (auth)

22042 ELECTRON–PHONON MASS ENHANCEMENT IN CERIUM. Mukhopadhyay; G.; Gyorffy, B. L. (Tata Inst. of Fundamental Research, Bombay). J. Phys., F (London); 3: No. 7, 1373-1380(Jul 1973).

Using a simple theory for the electron–phonon mass enhancement, the mass enhancement factor λ for γ and α cerium was calculated. From the results, a reasonable understanding of the band structures in γ and α Ce emerges. For γCe, the estimated value of λ is in good agreement with the experimental value. For αCe, the position and the width of the f band was obtained. The estimated width agrees well with those reported by others. (auth)

22043 EFFECT OF OXYGEN CONTENT ON THE IMPACT BEHAVIOR OF THE TANTALUM-BASED ALLOY T111 AT 2400°F. Lundberg, L. B.; Johnson, K. A. Met. Rev. (Publ. in Metals Mater.); 1: No. 1, 32-36(Sep 1972).

A fractographic study of O-doped Ta-based alloy T-111 (Ta–8 W–2 Hf) was made. Plates of T-111 at 2400°F (1316°C) in Ar were impacted by a hemispherical punch driven at ~34 ft/s by a Magnaform machine. Scanning electron microscopy and optical metallography were used in determining that T-111 containing ≳2000 ppM O may be considered brittle under the temperature and velocity conditions of the experiment. (Metals Abstr.)

22044 NEW REVERSAL EFFECT IN InSb. Andrianov, D. G.; Brandt, N. B.; Ioon, E. R.; Fistul', V. M.; Chudinov, S. M. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 356-358(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 494-498(5 May 1973).

Beats and a reversal effect were observed in one and the same narrow interval of carrier density in an investigation of Shubnikov–de Haas oscillations in n-InSb doped with Te. The reversal effect consists of a qualitative change in the picture of the oscillations when the magnetic field is reversed. Possible causes of the indicated effects are discussed. (auth)

22045 $SmCo_5$ CRYSTALS WITH MAGNETIC ENERGY 32 MILLION GAUSS-OERSTED. Ermolenko, A. S.; Korolev, A. V.; Shur, Ya. S. (Inst. of Metal Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 359-360(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 499-501(5 May 1973).

A single-domain state with magnetic energy 32 million G–Oe was obtained in bulky single crystals of $SmCo_5$ by delaying the formation and growth of the magnetization-reversal nuclei. This is the theoretical limit of this material and never before attained in permanent magnets at room temperature. (auth)

22046 EFFECT OF PRESSURE ON MAGNETIC BREAKDOWN IN BERYLLIUM. Alekseevskii, N. E.; Nizhankovskii, V. I.

(Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 250-251(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 344-348(5 Apr 1973).

The influence of hydrostatic compression on magnetic breakdown in beryllium is investigated. It is shown that the breakdown field decreases with pressure. (auth)

22047 THERMAL EXPANSION OF InBi. Takano, K.; Sato, T. (Tokyo Metropolitan Univ.). Phys. Lett.; 44A: No. 5, 309-310 (2 Jul 1973).

Linear thermal expansion of InBi single crystal was measured between −186 and 100°C. Lattice constant a shows a normal behavior over the measured temperature range. Lattice constant c, however, contracts monotonically with increasing temperature in this range. (auth)

22048 PSEUDOPOTENTIAL CALCULATION OF THE ELECTRONIC STRUCTURE OF A TRANSITION METAL: NIOBIUM. Fong, C. Y. (Univ. of California, Davis); Cohen, M. L. Phys. Lett.; 44A: No. 5, 375-376(2 Jul 1973).

The electronic structure and density of states are calculated for niobium using the Empirical Pseudopotential Method with a nonlocal d-potential. The results are in good agreement with APW calculations for states near and below E_F indicating that the niobium pseudopotential can be used for pseudopotential calculations of niobium compounds. (auth)

22049 CORRELATION BETWEEN COERCIVE FIELD AND STRUCTURE OF $SmCo_5$. Khan, Y.; Qureshi, A. H. (Ruhr Univ., Bochum, Ger.). J. Less-Common Metals; 32: No. 2, 307-310 (Aug 1973).

The coercive field of pressed $SmCo_5$ powder compacts was measured as a function of annealing temperature. Like the data of F. F. Westendorp, the results show a minimum at ~700 to 780°C and a maximum at 1000−1200°C. X-ray diffraction measurements show that annealing below 1150°C results in the decomposition of $SmCo_{5+x}$ into $SmCo_{5-x}$ and Sm_2Co_{17}, and that the phase precipitating at 780°C is the high-temperature Sm_2Co_{17}(h) phase ($CaZn_5$-type) and that precipitating at 980°C is the low-temperature Sm_2Co_{17}(t) phase (Th_2Zn_{17}-type). At 1150°C, $SnCo_{5-x}$ recombines with Sm_2Co_{17}(t) to give a more perfect $SmCo_5$, and the process is reversible. Stresses produced during compaction are probably responsible for the anomalous precipitation. (DLC)

22050 ELASTORESISTANCE EFFECT OF NIOBIUM. Martin, M. C. (Clarkson Coll. of Tech., Potsdam, NY). J. Less Common. Metals; 32: No. 2, 311-313(Aug 1973).

Nb wires were put under tension (T) and the resistance (R) at 77.4°K measured as a function of tension. The change was found to be positive and linear, with an elastoresistance coefficient of $[(1/T)(\Delta R/R)] = 1.704 \times 10^{-4}$ mm²/kg and an elastoresistivity coefficient $[(1/T)(\Delta\rho/\rho)] = 1.49 \times 10^{-4}$ mm²/kg. (DLC)

22051 SOLUBILITIES OF THORIUM AND SAMARIUM IN LIQUID LITHIUM−LEAD SOLUTIONS. Smith, F. J. (Oak Ridge National Lab., TN). J. Less-Common Metals; 32: No. 2, 297-300 (Aug 1973).

The solubilities of thorium and samarium in lead and several lithium−lead alloys were determined at temperatures between 400 and 800°C. The solubility of thorium in lead is represented by the expression $\log S_{Th}(\text{wt }\%) = [4.66 - 5560/T(°K)] \pm 0.1$. At each temperature, the solubility of thorium in lithium−lead solutions increased regularly as the lithium concentration was increased from 0 to 44 at. %. The solubility of samarium in lead can be expressed as $\log S_{Sm}$ (wt %) = [5.01−4656/T(°K)] ± 0.04. The solubility of samarium in lithium−lead solutions at a given temperature also increased as the lithium concentration was increased. (auth)

22052 STRESS RELAXATION OF A COPPER−1.87 WT % BERYLLIUM ALLOY. Rohde, R. W.; Nordstrom, T. V. (Sandia Labs., Albuquerque, NM). Mater. Sci. Eng.; 12: No. 3/4, 179-185(1973).

Stress relaxation experiments were used to study the deformation behavior of a precipitation hardening copper−1.87 wt % beryllium alloy. The precipitate was found to strengthen the material mainly by increasing the long-range internal stress. However, the parameters describing thermally activated deformation were found to differ from parameters previously determined in copper and copper solid-solution alloys. Cold working prior to aging did not change the parameters of thermal activation but increased the strength of the alloy by further raising the long-range internal stress. (7 figures, 22 references) (auth)

Radiation Effects

Refer also to abstracts 23471−23475, 23478−23481, 23515, 23521, and 23540.

22053 (CONF-730831-1) EFFECTS OF IMPURITY LEVEL ON ELECTRON RADIATION DAMAGE IN ALUMINUM AT ELEVATED TEMPERATURES. Stiegler, J. O.; Farrell, K. (Oak Ridge National Lab., Tenn.). [nd]. 12p. Dep. NTIS $3.00.

An increase in the general level of impurities affects the formation of loops and the evolution of dislocation structure in Al and Ni during bombardment with 650-kV electrons at elevated temperatures in a HVEM. In Al at 220°C, decreasing purity increases the concentration of loops, reduces their growth rates, increases the time to reach a steady-state dislocation structure, and reduces the cutoff temperatures for loop formation, indicating that impurities enhance the nucleation of loops and suppress their growth. Annealing and re-irradiation experiments just below the cutoff temperature suggest that some loops may be reinitiated at their original sites implying nucleation at impurities or submicroscopic defects. The development of large, multiply faulted loops occurs in the higher-purity materials in the near-surface regions after prolonged irradiation and considerable dislocation movement. (auth)

22054 (COO-2119-5) EXPERIMENTS IN HIGH-VOLTAGE ELECTRON MICROSCOPY. Progress Report. Mitchell, T. E.; Das, G.; Kenik, E. A.; Sklad, P. S. (Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science). 1 Aug 1973. Contract AT(11-1)-2119. 23p. Dep. NTIS $3.25.

Dislocations provide a biased sink for interstitials, and thus voids cannot be produced in thin areas of annealed foils because the foil surface is an effective sink for both point defects and dislocations produced by loop formation. However, voids can be produced if the flux is increased, if foils are deformed and contain a high dislocation density, or if thicker areas are irradiated. Results are reported on: (a) radiation-induced and radiation-enhanced precipitation in an Al−4% Cu alloy (G.P. zones and θ′ precipitates) and in a 304 stainless steel ($M_{23}C_6$ precipitates), (b) preliminary observations on the precipitate structures of some commercial cobalt alloys (WI 52) in the as-cast and heat-treated form, (c) defect clusters produced by radiation damage in vanadium, (d) displacement damage and ionization damage in synthetic quartz, resulting in a transformation to the amorphous state, and (e) black spot defects produced by irradiation of sapphire (Al_2O_3). (9 figures, 22 references) (auth)

22055 (COO-3158-20) FIELD-ION-MICROSCOPE STUDY OF THE POINT-DEFECT STRUCTURE OF A DEPLETED ZONE IN ION (W^+)-IRRADIATED TUNGSTEN. Report No. 2027. Wilson, K. L.; Seidman, D. N. (Cornell Univ., Ithaca, N. Y. Materials Science Center). 12 Jun 1973. Contract AT(11-1)-3158. 25p. (CONF-730813-9). Dep. NTIS $3.25.

From conference on defects and defect clusters in b.c.c. metals and their alloys; Gaithersburg, Maryland, USA (14 Aug 1973).

A quantitative field ion microscope study was made of the point-defect structure of a depleted zone detected in a high-purity zone-refined tungsten specimen (an uncorrected resistivity ratio, between 298 and 4.2°K, of greater than 4×10^4 as measured on a 1-mm-dia specimen) irradiated in situ under high-vacuum conditions ($<5 \times 10^{-7}$ torr) at a specimen temperature of 473°K with 20-keV W^+ ions to a dose of $\simeq 9 \times 10^{11}$ W^+ ion cm^{-2}. The irradiated specimen was examined at 25°K by the pulse-field evaporation technique and a total of 2.0×10^3 frames of 35-mm ciné were recorded and analyzed in the reconstruction of this depleted zone. The depleted zone was found to consist of 41 vacant lattice sites clustered in a cubic region of approximately 13 Å on a side. No contrast effects that could be attributed to self-interstitial atoms were found in or near the depleted zone or in the lattice surrounding it. If only first-nearest-neighbor vacant lattice sites are considered, then the distribution of cluster sizes is as follows: (1) three monovacancies; (2) one divacancy; (3) one trivacancy; (4) one six-vacancy cluster; and (5) one huge cluster of 27 vacancies. It was shown that this depleted zone was created by a single incident ion, and a comparison of the measured number of vacant lattice sites with the value predicted by the Kinchin−Pease model showed directly that this model overestimates the number of displacements created per incident ion by a factor of approximately five in this case (irradiation temperature of 473°K). A diffusion model is also presented that explains the temperature dependence of the size of a depleted zone in terms of the mean range of a focused-collision replacement sequence at a given irradiation temperature. (auth)

22056 (FRNC-TH-387) MEASUREMENT OF THE VOLUME ELASTIC EFFECT IN COPPER AND NICKEL; STUDY OF THE INTERACTION BETWEEN POINT DEFECTS, BLOCH WALLS, AND DISLOCATIONS IN NICKEL. Soulie, J. C. (Grenoble Univ. (France)). 1973. 148p. (In French). Dep. NTIS (U. S. Sales Only) $9.50.

Thesis.

Copper and nickel samples were irradiated with 2-MeV electrons at 45°K. The mutual interaction between point radiation defects was studied together with the interaction between these

defects and dislocation lines on the Bloch walls (in the case of ferromagnetics). The existence of these interactions was established from two series of simultaneous measurements made on defects in the elastic modulus $\Delta E/E$ and internal friction. The buried vibrating blade technique was used. The vibrations of the rectangular blade sample (buried at one end) were electrostatically excited in a good vacuum (minimum 10^{-4} torr) to a frequency of the order of kilohertz. In order to test the apparatus, the pinning of dislocations was studied and the volume elastic effect was measured for irradiated copper; the results obtained are compared with previously acquired data. Nickel samples were then studied in the same way. Simultaneous observations were then made of the pinning of dislocations, coupling effects between the anisotropy of the defects and the magnetization and recovery volume effects. The results obtained for nickel are difficult to explain in terms of the (crowdion) migration model at the I(E) stage even when the different variants proposed for the defects are considered. The observations are, however, compatible with the dissociated interstitial migration model without the inclusion of supplementary hypotheses. (FR)

22057 (HEDL-SA-561) APPLICATION OF HVEM TO THE STUDY OF RADIATION DAMAGE IN METALS. Laidler, J. J.; Mastel, B. (Westinghouse Hanford Co., Richland, Wash. (USA)). [nd]. 14p. (CONF-730816-3). Dep. NTIS $3.00.

From EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973).

Advantages provided by high voltage electron microscopy (HVEM) electron-irradiation studies of radiation damage in metals are reviewed. Since the relatively recent time of its availability for continuous monitoring of microstructural changes, it has already led to a better understanding of damage processes and can be expected to provide significant assistance and guidance in the application of materials design to complex components required to serve in a radiation environment. (JRD)

22058 (ORO-3612-10(Pt.1)) INVESTIGATION OF IRRADIATION STRENGTHENING OF bcc METALS AND SOLID SOLUTIONS. Progress Report, January–October 1973. (Maryland Univ., College Park). 1973. Contract AT(40-1)-3612. 186p. Dep. NTIS $11.50.

Research on the mechanisms of irradiation strengthening of bcc metals and their solid solutions is reported. Data and information are presented on low-temperature deformation of group Va metal–hydrogen single crystals, yield stress induced by chemical etching of V, glide forces between non-spherical defects and dislocations, neutron-irradiation softening and effects of interstitials in strengthening, interstitial concentration dependence of hardening in neutron-irradiated V, dislocation motion in neutron-irradiated Fe–Ni alloys, and anneal hardening in neutron-irradiated V alloys. The data and information are contained in appendixes to the report. The substances of these appendixes have or will be presented in separate reports. (JRD)

22059 (RISO-M-1625) ANALYSIS OF RIDGE FORMATION. Kjaer-Pedersen, N. (Danish Atomic Energy Commission, Risoe. Research Establishment). 15 Jun 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

A mathematical model is discussed that analyzes the elastic and plastic deformation of a tube under a specified local load applied axisymmetrically to the inner tube surface. The model accounts for anisotropic plastic properties of the materials. Creep behavior during irradiation is described by a model by Nichols (J. Nucl. Mater., 30: 249 (1969)). Numerical results were obtained by means of a digital computer. A discussion of these results is given. (auth)

22060 COMPARISON OF DIFFUSE SCATTERING BY DEFECTS MEASURED IN ANOMALOUS TRANSMISSION AND NEAR BRAGG REFLECTIONS. Larson, B. C.; Young, F. W. Jr. (Oak Ridge National Lab., TN). Z. Naturforsch., A; 28: No. 5, 626-632 (1973).

The diffuse scattering from neutron-irradiation-produced defects in copper was measured in anomalous transmission and near the (111) Bragg reflection. The results were related through the theory of Dederichs, and the intensities and forms of the scattering curves obtained from the two measurements were found to be in good agreement over a wide range of defect concentrations and sizes. 5 figures. (GE)

22061 MICROSTRUCTURE OF STAINLESS STEEL STRESSED DURING NEUTRON IRRADIATION. Brager, H. R.; Gilbert, E. R.; Straalsund, J. L. (Westinghouse Hanford Co., Richland, WA). Scr. Met.; 7: No. 8, 847-850(Aug 1973).

Results of a microstructural study of 20% cold-worked Type 316 stainless steel stressed during neutron irradiation are: (1) The transient in-reactor creep occurred simultaneously with an appreciable reduction in the dislocation density. (2) Relative to irradiation, stress of 138 MN/m^2 (20,000 psi) had only a minor influence on the microstructure. (3) The irradiation creep occurred independently of swelling since no voids were formed in either the stressed or unstressed material. (4) Uniaxially applied stress influenced Frank-loop growth rates while biaxial stress did not. (5) Irradiation creep does not appear to be controlled by the strain associated with stress-biased Frank-loop growth. (6) No correlation was found between stress and loop nucleation. (auth)

22062 VACANCY VERSUS INTERSTITIAL MIGRATION IN ELECTRICAL-RESISTIVITY RECOVERY STATES III AND IV OF MOLYBDENUM. Stals, L. (SCK–CEN, Mol, Belgium); Nihoul, J.; Cornelis, J.; De Meester, P. Phys. Status Solidi (a); 18: No. 1, 283-293(16 Jul 1973).

An analysis was made of published data on the electrical-resistivity recovery stages III and IV of molybdenum, completed with new results on the influence of various cold-work defect populations on the recovery kinetics of stages III and IV. More specifically, the compatibility of the experimental data with various recovery models, i.e., the interstitial model and some variants of the vacancy model for stage III, was investigated. It is shown that only the interstitial model, implying migration of interstitials in stage III (0.16 T_m) and of vacancies or divacancies in stage IV (0.20 T_m), is compatible with all experimental data. From the relation between the defect concentration and the peak temperature of stage III, a lower limit was deduced for the mean diameter of the displacement cascade in molybdenum being equal to (20 ± 5) lattice distances. (4 figures, 2 tables, 39 references) (auth)

22063 ELECTRON-IRRADIATION HARDENING OF COPPER AND COPPER ALLOYS AT 78 AND 300 K. Kamada, K.; Yoshizawa, I.; Naramoto, H. (Japan Atomic Energy Research Inst., Tokai). Phys. Status Solidi (a); 18: No. 1, 377-386(16 Jul 1973).

Electron irradiation hardening of Cu, Cu–Ni, Cu–Si, and Cu–Ge single crystals was measured at 78 and 300°K. From a comparison with the theory of Frank, it is concluded that the hardening after 78°K irradiation is due to interstitial tetragonality. After 300°K irradiation, an extraordinarily large hardening rate per point defect introduced is observed. Although the mechanism of this hardening is not understood in detail, it is attributed to interstitial clusters. It is concluded that interstitial atoms, which exist individually or as complex with solute atoms after 78°K irradiation, move and form clusters at higher temperatures. The temperature dependence of the yield stress after electron irradiation was measured and the effect of the irradiation on the anomaly below 100°K was observed. (6 figures, 5 tables, 24 references) (auth)

22064 ROLE OF DEPLETED ZONES IN NEUTRON-IRRADIATED METALS. Inal, O. T.; Murr, L. E. (New Mexico Inst. of Mining and Tech., Socorro). Phys. Status Solidi (a); 17: No. 2, K93-K96(16 Jun 1973).

Depleted zones formed in Pt and other metals are not observable by transmission electron microscopy (TEM). The density of the depleted zones is far greater than that of the interstitial loops (the black dots observed by TEM). It is shown that the effect of neutron irradiation at elevated temperatures is different from that at reactor temperatures. TEM cannot be used alone to study irradiation-induced defects; field-ion microscopy (FIM) must also be used. Annealing cannot be used to simulate irradiation damage at higher temperatures. (DLC)

22065 ELECTRON-BOMBARDMENT INDUCED ANNEALING STAGES IN N TYPE GERMANIUM. I. Hirata, M. (Osaka Univ., Toyonaka, Japan). Jap. J. Appl. Phys.; 12: No. 4, 577-585(Apr 1973).

Germanium single crystals containing P, As, and Sb were irradiated with electrons having the energy of 1.5 MeV at 77 K. Isothermal annealing of radiation-induced resistivity was studied at a number of temperatures in detail. Two normal annealing stages were observed. The earlier stage labeled as stage I appeared to have an impurity independent activation energy of 0.75 eV, while the later stage (stage II) showed an impurity dependence. Stage I might possibly arise from intrinsic defects like divacancy. Annihilation of impurity associated defects is considered to be the most likely source of the stage II defects. An additional reverse annealing stage was observed only in the case of arsenic-doped crystals. (auth)

22066 DISPLACEMENT MECHANISMS IN ELECTRON-IRRADIATED MOLYBDENUM. Rizk, R.; Vajda, P.; Lucasson, A.; Lucasson, P. (CNRS, Orsay, France). Phys. Status Solidi (a); 18: No. 1, 241-246(16 Jul 1973).

Electron irradiation of 99.95% VP-grade molybdenum and of 99.992% Marz-grade molybdenum in the energy range 0.8 to 1.7 MeV at 5 to 8°K yielded apparent threshold energies for displace-

ment of E_d^{VP} = (810 ± 40) keV and E_d^{MG} = (850 ± 40) keV, respectively. Best fitting with a theoretical displacement cross section was obtained using two-step displacement probability functions of the form $P_d^{VP} = 0$ for $T < 33$ eV, $P_d^{VP} = 0.18$ for $33 \leq T < 42$ eV, $P_d^{VP} = 0.60$ for $T \geq 42$ eV and $P_d^{MG} = 0$ for $T < 35$ eV, $P_d^{MG} = 0.15$ for $35 \leq T < 43$ eV, $P_d^{MG} = 0.85$ for $T \geq 43$ eV, respectively. The observed differences are explained by a ⟨12⟩ texture of the Marzgrade material. (21 references) (auth)

22067 ELECTRONIC ENERGY LOSS OF IONS IN THE MODIFIED FIRSOV THEORY. Komarov, F. F.; Kumakhov, M. A. (Lenin State Univ., Minsk). Phys. Status Solidi (b); 58: No. 1, 389-400(1 Jul 1973).

An analytical version is derived of the modified Firsov theory for the calculation of inelastic energy losses of ions traversing through crystalline and amorphous targets. Shell effects are included. The model describes correctly the dependence of the inelastic energy loss on the atomic number of the target atoms and incident ions and yields a fair agreement with experimental data. (auth)

22068 THE "SHADOW EFFECT" IN THE BOMBARDMENT OF SINGLE CRYSTALS BY HEAVY IONS. Panin, S. D.; Lebedev, S. Y.; Dubinskii, V. E. Sov. Phys.-Solid State 14: No. 8, 2123-2124 (Feb 1973).

The shadow patterns observed on a fluorescent screen during the bombardment of tungsten and copper single crystals by heavy ions (Ar^+ and N_2^+) and protons at 70 keV are compared. (CES)

22069 EFFECT OF AGING AND IRRADIATION ON THE CORROSION OF Zr-2.5 wt. % Nb. Urbanic, V. F.; LeSurf, J. E.; Johnson, A. B. Jr. Paper No. 102. Houston, TX; National Association of Corrosion Engineers (1973). 13p.

Specimens of Zr-2.5 Nb alloy were quenched from 870°C in water, cold worked, and then thermally aged for various temperatures and times. After irradiation in a water-cooled power reactor, the specimens were examined for corrosion. Some irradiated and unirradiated specimens were then re-exposed in an out-reactor autoclave to determine the effects of the oxide formed in the reactor on corrosion. Results show that quenched, cold-worked and aged Zr-2.5 Nb alloy corrodes less in pressurized water during in-reactor irradiation than during exposure to similar conditions outside of the reactor. The beneficial effect of irradiation on in-reactor corrosion is complete at or before a fluence of 3.3×10^{20} n/cm^2. In-reactor corrosion is not dependent on aging time and temperature. Out-reactor corrosion and the decrease in corrosion produced by irradiation do, however, depend on those factors to a degree related to the extent of Nb supersaturation. (Metals Abstr.)

22070 DISORDERING-ORDERING REVERSIBLE PROCESSES AT LOW TEMPERATURE IN MARTENSITE OF ELECTRON-IRRADIATED CARBON STEEL. Kritskaya, V. K.; Narkhov, A. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 35: No. 6, 1264-1270(1973). (In Russian).

New states of the martensite and residual austenite of tempered carbon steel, caused by electron irradiation, were studied by radiographic methods. It was established that these states are characterized by reversible changes of the lattice parameters of the α and γ phases of the carbon steel, unrelated to the change of the carbon concentration in the solid solution. The reversible changes detected in the tetragonal lattice of the irradiated martensite were caused by the redistribution of the carbon in the Fe_α-C solid solution (reversible processes of ordering-disordering). (tr-auth)

22071 INFLUENCE OF IRRADIATION ON ANISOTROPY ENERGY OF IRON-NICKEL FILMS. Mil'ner, A. A.; Tatarinova, L. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 35: No. 6, 1312-1313(1973). (In Russian).

The effect of electron and proton irradiation on the anisotropy energy and the structure of films of 50% Ni-50% Fe was studied. Results showed that the anisotropy energy increases after electron irradiation on an average of 17%, and the maximum increase after proton irradiation was 8%. (JSR)

22072 CHANGE OF MECHANICAL PROPERTIES OF MOLYBDENUM SINGLE CRYSTALS AFTER ELECTRON IRRADIATION AND DEPENDENCE ON CRYSTALLOGRAPHIC ORIENTATION. Kritskaya, V. K.; Il'ina, V. A.; Vasil'ev, A. A. (Central Scientific Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 35: No. 5, 1114-1115(1973). (In Russian).

Results showed that for crystals with orientation of the axis of tension along the [110] direction, substantial change of the mechanical characteristics did not occur after irradiation. In crystals with [111] orientation, an increase of the tensile strength and yield stress was detected. (JSR)

22073 SURFACE DAMAGE AND TOPOGRAPHY CHANGES PRODUCED DURING SPUTTERING. Nelson, R. S.; Mazey, D. J. (Atomic Energy Research Establishment, Harwell, Eng.). Radiat. Eff.; 18: No. 1-2, 127-134(Mar 1973).

From international conference on ion-surface interaction, sputtering, and related phenomena; Garching, Germany (Sep 1972).

Ion bombardment of solids creates radiation damage in the form of interstitials and vacancies that agglomerate into dislocation structures, so becoming visible in the electron microscope. Furthermore, ion bombardment causes sputtering of atoms from the surface of solids, which can give rise to changes in surface topography. This paper briefly reviews the salient features of these two phenomena and, in particular, points out their interrelation. (auth)

Other Materials

Refer also to abstracts 20806, 20818, 20840, 21970, 22073, 22403, 23113, 23269, 23437, 23661, 23675, 23899, 23904, 23905, 23917, 23923, 23932, 23964, 23982, 23988, 23999, 24001, 24035, 24038, 24050, and 24056.

22074 (COO-1105-184) RADIATION- AND IMPURITY-INDUCED THERMALLY ACTIVATED CHARGE TRANSPORT IN CALCIUM FLUORIDE. Podgorsak, E. B.; Moran, P. R. (Wisconsin Univ., Madison). 9 May 1973. 4p. Dep. NTIS $3.00.

Impurity-induced thermally activated processes studied included the ionic space-charge electret state, the dipolar electret state, and the ionic conductivity. Radiation-induced thermally activated processes include thermoluminescence, thermally activated current, and the local RITAD effect. (JRD)

22075 (COO-1105-189) ELECTRON SPIN RESONANCE OF SELF-TRAPPED HOLES IN CALCIUM FLUORIDE. Fuller, G. E.; Moran, P. R. (Wisconsin Univ., Madison). 1973. 11p. Dep. NTIS $3.00.

Electron spin resonance was used to study the formation, annealing, and spin-lattice relaxation of self-trapped holes in Harshaw calcium fluoride single crystals. A simple single saturating exponential formation behavior and a two component first-order decay annealing behavior was found. This annealing behavior is in partial disagreement with previous reports on CaF_2 self-trapped hole annealing, but in very good agreement with thermoluminesence and electrical measurements on the same samples. A thermally activated spin-lattice relaxation rate for the self-trapped holes is reported. (auth)

22076 (COO-1105-190) PRELIMINARY ELECTRON SPIN RESONANCE STUDIES ON RADIATION DAMAGE CENTERS IN LiF (TLD-100). Fuller, G. E.; Moran, P. R. (Wisconsin Univ., Madison). 1973. 6p. Dep. NTIS $3.00.

Preliminary studies of the electron spin resonance spectra of x-ray-induced damage centers in LiF (TLD-100) were performed, using a pulse-annealing technique in the temperature range from 77 to 800°K. A number of changes are observed in the spectra as the annealing temperature is progressively increased. Most of the paramagnetic centers involved in these changes were not identified, but the temperatures at which the changes take place can be correlated to some of the well-known thermoluminescent glow peaks in this material. (auth)

22077 (COO-1105-193) RADIATION RESPONSE OF A NEW ELECTRET EFFECT IN IONIC SOLIDS. Podgorsak, E. B.; Fuller, G. E.; Moran, P. R. (Wisconsin Univ., Madison). 1972. 5p. Dep. NTIS $3.00.

By pre-poling a high-temperature electret state in ionic materials, the solid becomes very sensitive to lower-temperature radiation-induced thermally activated depolarization (RITAD) phenomena. These local field RITAD effects are many orders of magnitude more sensitive than radioelectret response. There appears to be great potential for local RITAD phenomena in sensitive radiation dosimetry. (auth)

22078 (COO-1105-199) RADIATION-INDUCED THERMALLY ACTIVATED POLARIZATION TRANSFERS IN CaF_2. Podgorsak, E. B.; Moran, P. R. (Wisconsin Univ., Madison). 1973. 14p. Dep. NTIS $3.00.

The strong radiation-induced thermally activated depolarization (RITAD) effect previously reported in CaF_2 can be identified with a corresponding polarization (RITAP) phenomenon. These RITAP and RITAD effects are extremely radiation-sensitive and consist of polarization transfers among electron, hole, and ionic charge transport states of the material. Net sample polarization is independent of radiation exposure for exposures smaller than 10^3R. (auth)

22079 (DP-MS-71-84) MAGNETIC PROPERTIES OF UCl_3, UBr_3, $NpCl_3$, $NpBr_3$, AND $PuCl_3$. Jones, E. R. Jr.; Hendricks,

M. E.; Stone, J. A.; Karraker, D. G. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 21 Feb 1972. 17p. (CONF-720353-1). Dep. NTIS $3.00.

Magnetic susceptibilities of the isostructural compounds UCl_3, UBr_3, $NpCl_3$, $\alpha-NpBr_3$, and $PuCl_3$ were measured from 3 to 100°K (nominal), with a vibrating-sample magnetometer at applied fields up to 12,000 Oe. U^{3+}, Np^{3+}, and Pu^{3+} have C_{3h} site symmetry in these compounds. Antiferromagnetic transitions were observed in UCl_3, $T_N = 22.0 \pm 1.0$°K; in UBr_3, $T_N = 20.0 \pm 1.0$°K; and in $PuCl_3$ $T_N = 4.5 \pm 0.5$°K. Temperature-independent paramagnetism was observed in $NpCl_3$ below 50°K, and in $\alpha-NpBr_3$ below 30°K. Each of the compounds exhibited Curie–Weiss behavior at higher temperatures, with effective moments closely approximating the free-ion moments. For $PuCl_3$, the experimental susceptibility from 10 to 100°K is in excellent agreement with values calculated from known crystal-field energy levels and wave functions. (auth)

22080 (UCID-16329) PROPERTIES OF ADIPRENE L-100/MOCA AS A ROOM-TEMPERATURE-CURED ADHESIVE AND POSSIBLE SUBSTITUTES FOR IT. Hammon, H. G. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Jun 1973. Contract W-7406-eng-48. 17p. Dep. NTIS $3.00.

Adiprene L-100/MOCA has been used as a room-temperature-cured adhesive in nuclear weapons and devices because (1) it cures at room temperature in a reasonable period of time without releasing solvents or volatile fragments, (2) it is compatible with HE and with LiH and similar salts, (3) it gives a good bond strength and will bond to most clean surfaces without a primer, and (4) it has a relatively low modulus that allows for some gap changes due to different coefficients of thermal expansion of the substrates. Recent restrictions on its use by OSHA (Occupational Safety and Health Act) make it desirable to review the properties of the material and to look for permissible substitutes. This report reviews the pertinent properties of Adiprene L-100/MOCA and suggests some possible substitutes for it. Possible substitutes include Adiprene LW-520 cured with MDA, Conap's Conathane EN-5 and EN-7, CPR's Castethane 2124, polyolcured Adiprene L-167 and L-315, some polyamide-cured epoxies, and some silicones. (6 tables, 5 figures) (auth)

22081 ANALYSIS OF THIN EPITAXIAL LAYERS OF GaAs USING MeV α particles. Wood, D. R.; Morgan, D. V. (Univ., of Leeds, Eng.). Phys. Status Solidi (a); 17: No. 2, K143-K147 (16 Jun 1973).

The Rutherford scattering/channeling effect was used to study epitaxial layers. The spectrum of the backscattering of 4-MeV α particles from an epitaxial GaAs crystal grown on a ⟨100⟩ n^+ Te-doped substrate, shows a minimum yield of 0.04, a value very close to that of high-quality bulk crystals. The film was thinned, and the minimum yield and rate of dechanneling were studied as functions of depth. A disordered region near the interface associated with the initial growth and a localized region of high defect content were observed. Impurities detected are tabulated. (DLC)

22082 THERMALLY STIMULATED AQUOLUMINESCENCE OF γ-IRRADIATED ALKALI HALIDES. Gikas, G. X. (National Technical Univ., Athens). Phys. Status Solidi (a); 17: No. 2, 517-520(16 Jun 1973).

The recently reported emission of photon pulses, in the range of 400 to 600 nm, during the dissolution of γ-irradiated alkali metal halides (NaCl, KCl, KBr, and LiCl) in water, was studied as a function of temperature. It is found that the rise time, pulse height, number of emitted photons, and decay time are strong functions of temperature in the range 0 to 90°C. The increased number of photons are due to the increased thermal excitation. Thermal stimulation provides an inexpensive and simple method for the enhancement of the generation and availability of hydrated electrons, and on the other hand, is an indirect method for the study of color centers. (auth)

22083 ADSORPTION AND DESORPTION KINETICS OF Cu AND Au ON (0001) GRAPHITE. Arthur, J. R.; Cho, A. Y. (Bell Telephone Labs., Inc., Murray Hill, NJ). Surface Sci.; 36: No. 2, 641-660(May 1973).

The interaction of Au and Cu atoms with the (0001) plane of graphite was studied by mass-spectrometric measurements of desorption flux both in the presence and absence of an incident atomic beam. For these systems the condensation coefficient increases from ~ 0.05 at $\theta = 0$ to unity at $\theta = 1$; furthermore the rate of thermal desorption has a kinetic order of one-half for both systems at low coverage. These observations are consistent with a kinetic model in which two-dimensional nucleation of mobile adsorbed atoms occurs upon adsorption, while the reverse process, loss of atoms from the edges of disc nuclei, is the rate controlling step for desorption. This model implies that bonding of metal atoms to the basal plane of graphite is weak and nonlocalized, with adsorption occurring only when two-dimensional nucleation permits metal–metal bonding. (29 references) (auth)

22084 CONCENTRATION PROFILES OF IMPLANTED BORON IONS IN SILICON FROM MEASUREMENTS WITH THE ION MICROPROBE. Schwarz, G.; Trapp, M.; Schimko, R.; Butzke, G.; Rogge, K. (VEB Werk fuer Fernsehelektronik, Berlin). Phys. Status Solidi (a); 17: No. 2, 653-658(16 Jun 1973).

The ion microprobe allows the measurement of the chemical concentration profiles of boron in silicon between 10^{16} and 10^{21} cm^{-3}. Boron layers are investigated which were implanted with energies from 50 to 300 keV and a dose of 5×10^{14} cm^{-2}. The projected ranges and standard deviations are in good agreement with the electrical measurements by Seidel. The profiles are asymmetric and show a characteristic shoulder. The shape of the profile changes due to amorphization before implantation or in the presence of a thin oxide layer on the surface. Profiles, which were measured after annealing at different temperatures, show broadening by diffusion. (auth)

22085 EXPERIMENTAL STUDY OF Mg CENTERS STABLE AT RT IN X-IRRADIATED NaCl(Mg) CRYSTALS. Watterich, A.; Voszka, R. (Research Group on Crystal Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 33: No. 3-4, 323-334(1973).

Four types of Mg centers stable at room temperature were produced by bleaching of the F band in x-irradiated NaCl(Mg) single crystals. Absorption, thermoluminescence, ESR, photoconductivity, and thermal and optical stability measurements provided strong evidence that two of the centers are paramagnetic, consisting of a single substitutional Mg^+ ion and of a substitutional Mg^+ ion associated with a vacancy pair, respectively, while the other two are diamagnetic, consisting of a single interstitial Mg atom (Z_2 center) and of an interstitial Mg atom in a vacancy pair, respectively. (11 figures) (auth)

22086 F-CENTER PROFILES ASSOCIATED WITH ELECTRONIC STOPPING POWER IN LiF BOMBARDED WITH HIGH-ENERGY IONS. Perez, A.; Thevenard, P.; Davenas, J.; Dupuy, C. H. S. (Univ. Claude Bernard, Lyon). Phys. Status Solidi (a); 18: No. 1, 189-195(16 Jul 1973).

F-center profiles created in LiF with 56-MeV α-particles and 28-MeV deuterons are obtained at room temperature by an optical method using a microspectrophotometer. These profiles are analogous to Bragg's curves and are in good agreement with the calculated electronic stopping power but a departure from linearity above 10^{14} MeV cm^{-3} is observed. The energies per observed F center as a function of incident ion energy vary between 350 and 1550 eV for α particles and 530 and 1750 eV for deuterons. Results for samples irradiated in the (100) and (110) directions are similar. (7 figures, 18 references) (auth)

22087 SPECTRAL CHARACTERISTICS OF CaF_2–RARE EARTH FLUORIDE CRYSTAL LUMINESCENCE INDUCED BY GAMMA RADIATION. Vakhidov, Sh. A.; Kaipov, B.; Tavshunskii, G. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 4, 431-432 (Oct 1972).

Translated from Opt. Spektrosk. 33: No. 4, 782-783(Oct 1972).

A study was made of radiation-stimulated processes in CaF_2 doped with 0.1 to 1 wt % of the fluoride of Pr, Nd, Dy, Ho, Er, or Tm. The dose was between 10^6 and 10^7R, and the spectra of gamma-luminescence (GL), phosphorescence (PH), and photoluminescence (PL) were studied. The GL and PH spectra were found to coincide with each other, indicating that the same RE^{2+} centers and holes participate in the PH and GL processes. The effect of Pr and Nd ions is different from that of Dy, Ho, and Er. (DLC)

22088 EFFECT OF ELECTRON IRRADIATION ON THE CRYSTALLINE STRUCTURE OF ZnTe, CdS, AND PbTe THIN FILMS. Baltateanu, N. (Inst. of Atomic Physics, Bucharest); Spinulescu, I. Rev. Roum. Phys.; 18: No. 5, 661-663(1973).

Following electron irradiation with doses ranging between 5×10^7 and 2×10^{10} rad, important structural changes were observed in the crystallites of evaporated ZnTe, CdS and PbTe thin films. The effects of $\sim 10^8$ rad are very marked particularly in films with a very low degree of orientation obtained on substrates heated at low temperatures thermally nondegassed in vacuum. This effect consists in the complete disorientation of crystallites and the appearance of some large crystallites due to the "conglomeration" (recrystallization) of the small crystallites which coexist in the superficial layers of the samples. Subsequent to irradiation, the ZnTe, CdS and PbTe thin films, with a good structure and with a high degree of crystallite orientation, show an obvious improvement of the film structure. However, an additional increase of the irradiation dose up to 2×10^{10} rad leads to a thinning and even fading of the diffraction lines, which indicates a decrease in number of oriented small crystallites (at least in the first superficial layers of the sample to a depth of 80 to 100 Å) and the occurrence of the amorphous phase. (auth)

22089 WEAK-BEAM OBSERVATION OF DISLOCATION LOOPS IN SILICON. Bicknell, R. (Plessey Co. Ltd., Towcester, Eng.). J. Microscopy; 98: No. 2, 165-169(Jul 1973).

From EMCON symposium on applications of the weak beam technique in materials science; Manchester, England (12 Sep 1973).

Weak-beam microscopy was used to examine the dislocation loops formed when ion-implanted silicon is annealed in the temperature range 900 to 1300°K. The extinction distances of about 10 nm, resulting from the use of large deviation parameters S' enable stacking fault fringes of 4 nm spacing to be resolved in faulted loops. The projected shape of the dislocation loops and the variable contrast along the perimeter of the bounding partial dislocation enables the habit planes of the dislocation loops to be determined from inspection. These, together with the width of the dislocation image which is about 3 nm, enables the type of loop to be characterized completely from a single micrograph. (auth)

22090 THEORY OF MAGNETISM FOR SEMI-METALLIC URANIUM COMPOUNDS. Adachi, H.; Imoto, S. (Osaka Univ.). Int. J. Theor. Phys.; 34: No. 9, 1537-1542(Sep 1973).

A theoretical study is carried out to explain the magnetic properties of uranium compounds of NaCl, anti-Cu_3Sb, and Th_3P_4 type. The electronic model used is a modified free electron model along the lines of the band structure for NaCl-type uranium compounds previously reported. An exchange interaction via the conduction electrons is assumed for the mechanism of magnetic ordering. The molecular field approximation is used to calculate θ, T_N, and the exchange interaction constants. The stability range of various magnetic ordering states and the variation of θ, T_N, and exchange interaction constants are obtained as functions of lattice parameter. These results well explain the experimental data. (auth)

22091 ION IMPLANTATION AND ANALYSIS BY MEANS OF ION BEAMS. Elektro-Anz.; 5: No. 2, 36-37(1973). (In German).

The article highlights the advantages of ion implantation as compared to the drawbacks of diffusion techniques. A brief description of ion-implantation equipment follows. Finally, it is shown how to draw conclusions about material properties using ion-beam reflection techniques. (GE)

22092 NEW GRADUALLY GRADED p-i-n STRUCTURE PRODUCED BY ELECTRON IRRADIATION IN GERMANIUM. 1. Wada, T. (Mie Univ., Tsu, Japan); Fukuoka, Y.; Arizumi, T. Jap. J. Appl. Phys.; 11: No. 3, 343-350(Mar 1972).

In an n-type germanium wafer of 110 μm in thickness, exposed to a total flux of about 10^{16} electrons/cm^2 at 8 MeV, the sign of the Hall coefficient, measured as a function of thickness of the wafer, converts from negative to positive at a distance of about 50 μ from the surface. The formation of a gradually graded p-i (high resistivity i region)-n structure can be fairly well explained by taking account of the deep energy levels associated with the defects, the condition of charge neutrality and the range of the electrons. (auth)

22093 PRE-EXPONENTIAL FACTOR IN ELECTRICAL CONDUCTIVITY OF IRRADIATED POLYETHYLENE. Sawa, G. (Nagoya Univ., Japan); Ieda, M.; Kitagawa, K. Jap. J. Appl. Phys.; 11: No. 3, 416-417(Mar 1972).

High-energy irradiation of polyethylene usually gives rise to increase its electrical conductivity. It has been reported, however, (J. Phys. Soc. Japan, 18: 1103 (1963)) that the annealing above the melting point reduces the increased conductivity toward that of the unirradiated one, due to the annihilation of trapped carriers produced during the irradiation. This report is concerned with the pre-exponential factor in the expression of the electrical conductivity of gamma-irradiated polyethylene, which is once heated near the melting point. The polyethylene sample was Yukalon EH-30, a low-density polyethylene (30-μm thick, melting point (115°C) free of additives and nominally pure. All samples were irradiated at room temperature by a ^{60}Co γ-source having the maximum dose rate of 0.2 M rad/h. (LMT)

22094 EFFECTS OF GAMMA-RAY IRRADIATION ON PHOTOCONDUCTION OF POLYETHYLENE (PE). Mizuani, T.; Takai, Y.; Ieda, M. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 11: No. 3, 411(Mar 1972).

A 500-W xenon lamp with a water cell to avoid the thermal effect of infrared light was used as the light source. Samples were films of low-density PE about 20 μm in thickness and nominally free from antioxidants and other additives and were prepared with semitransparent Au-evaporated electrode and guard electrode. Some of them were irradiated by γ rays from Co^{60} in air. Typical dark- and photocurrents (J_d and J_p) of nonirradiated PE (n-PE) and γ-irradiated PE (γ-PE) are shown. Also shown are response curves of photocurrents induced by light filtered with UV-25, VY-45 and VR-60, which remove light in the wavelength region shorter than 250, 450 and 600 mμ, respectively. The photocurrent of n-PE was induced mainly by ultraviolet, while that of γ-PE was induced not only by ultraviolet light but also by visible and near-infrared light. This change in photoconduction due to γ-irradiation suggests the introduction of donors and traps distributed in wide range of energy. (LMT)

22095 INFRA-RED STUDIES OF CRYSTAL DEFECTS. Newman, R. C. London; Taylor and Francis (1973). 187p.

Chapter 7 of this book reviews electron and neutron irradiation effects on silicon, particularly electrons. Defects produced by irradiation introduce localized electronic levels into the forbidden energy gap and can act as electron traps or hole traps. The defects may give rise to infrared absorption due to associated localized vibrational modes or to modes which lie below the Raman frequency. The oxygen–vacancy center, silicon doped with carbon, germanium, or boron and ion-implanted silicon are reviewed in detail. The other chapters treat infrared absorption from a lattice containing point defects, vibrations of an anharmonic local oscillator, localized vibrations of H and D in alkaline earth fluorides, hydrogen ions in alkali metal halide crystals, one-phonon infrared absorption in Si and Ge, and compound III-V semiconductors. (DLC)

22096 FACTORS AFFECTING THE FORMATION OF U CENTERS BY PROTON IMPLANTATION OF ALKALI HALIDES. Hughes, A. E.; Pooley, D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 6: No. 13, 2094-2104 (9 Jul 1973).

The ultraviolet and infrared spectra of U centres formed by proton irradiation of alkali metal halides (KCl, KBr, RbCl, NaF, NaCl, KI) were used to measure their concentration in a study of the factors affecting the fate of the implanted protons. The efficiency of U centre formation varies from one material to another in a way which suggests that the creation of anion vacancies of sufficient size is necessary before U centres can be formed. The effect of temperature shows that the rate of U centre formation is limited by the diffusion of hydrogen species from the end of the proton tracks, and this is confirmed by depth distribution measurements. (auth)

22097 DISTRIBUTION OF FISSION PRODUCTS IN COATED FUEL PARTICLES STUDIED BY ION SPUTTERING. Loidl, A.; Pichlmayer, F.; Riehs, P. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). pp 211-214 of Post Irradiation Examination Techniques. London; British Nuclear Energy Society (1972).

Irradiated uranium carbide fuel particles were investigated using the sputtering method. The PyC/SiC/PyC coating shows within the SiC layer a steep gradient of ^{137}Cs concentration towards the kernel. This increase is followed by a maximum, which coincides presumably with the transition SiC/PyC. A similar distribution with much better pronounced maximum is found for ^{106}Ru. It is assumed that the maxima are caused probably by different partitions of Cs and Ru in SiC in comparison to the PyC layer. The increase of ^{144}Ce starts within the inner PyC coating. Analysing one particle in the outer PyC layer for ^{90}Sr, the same shape is found as for ^{144}Ce. (auth)

22098 ELECTROLYTIC DECOMPOSITION TESTS OF IRRADIATED AND NON-IRRADIATED GRAPHITE. Beone, G.; Lazzaretto, G.; Moccia, A. (CNEN, Rome). Kerntechnik; 15: No. 6, 270-272(1973).

Electrolytic decomposition of graphite is a possible head-end step for reprocessing HTGR fuels. Differences of behavior, with respect to electrolytic decomposition, between irradiated and nonirradiated graphite were ascertained. The rates of irradiated and nonirradiated graphite were, respectively, about 0.4 g/cm^2 h and 0.7 g/cm^2 h. The average particle sizes of decomposed graphite were 140 μm for nonirradiated graphite and 100 μm for irradiated. Microphotographic and x-ray-diffraction analyses showed, in irradiated graphite, an increase of pore sizes and of lattice disorder. (GE)

22099 STUDY ON THE PREPARATION OF WOOD–PLASTIC COMBINATION. I. General Properties and Radiation Durabilities of Woods. Pyun, H. C.; Lee, K. H.; Kim, J. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 150-158(Jun 1973).

General physical properties and radiation durabilities of some domestic woods and imported lauans were measured and discussed as a preliminary study on the preparation of W. P. C. The data obtained indicate that; 1) the hardness of wood is generally proportional to the specific gravity and to the bending strength, 2) the hardness of wood measured in tangential direction to the annual ring increases along with the distance from the center of the annual ring to the peel, 3) the changes of specific gravity under 100 Mrad γ irradiation are not remarkable, and 4) the hardnesses of the soft woods are decreased more readily than those of the hard woods, but the decreases of hardnesses are not extreme up

to 10 Mrad suggesting that the woods are sufficiently durable to γ irradiation of below 10 Mrad in the preparation of W. P. C. (auth)

22100 ELECTRIC FIELD EFFECT ON THE LUMINESCENCE OF KI:Tl. Nouailhat, A.; Perrenoud, R.; Aegerter, M. A.; Rossel, J. (Univ. Neuchatel, Switzerland). J. Lumin.; 6: No. 4, 245-255 (Jun 1973).

Thermoluminescence of KI:Tl, x- or β-irradiated at $T \leq 77°K$ shows two main peaks at 105°K and 170°K. They are respectively attributed to the recombination of mobile V_K centers with Tl^0 centers and to the recombination of thermally released electrons from Tl^0 centers with Tl^{2+} centers. Similar experiments performed under static electric fields ($E < 40$ kV cm^{-1}) show that the intensity of the second glow peak is strongly reduced. The relative intensity variation is anticorrelated with the intensity of glow peaks occurring at $T > 230°K$. It is suggested that in the temperature range in which Tl^0 centers are thermally ionized, the effect of the electric field is to favor the retrapping of these electrons on other traps (still unknown). Irradiation doses also play an important role and their effects are studied at T = 77 and 200°K. (auth)

22101 WHITE RADIATION NEUTRON-DIFFRACTION TECHNIQUES. Wilson, S. A.; Cooper, M. J. (Atomic Energy Research Establishment, Harwell, Eng.). Acta Crystallogr., Sect. A; 29: No. 1, 90-91 (1 Jan 1973).

In a recent paper Hubbard, Quicksall & Jacobson [Acta Cryst. (1972). A 28, 236-245] describe a highly efficient white-radiation neutron-diffraction technique. The present note discusses some of the problems which arise from the use of such techniques in the light of recent measurements at Harwell and emphasizes that, because of these problems, structure determination using white-beam techniques is less reliable than that possible using conventional monochromatic beam techniques. (auth)

22102 SPIN DIFFUSION AND SPIN-LATTICE RELAXATION KINETICS OF HYDROGEN ATOMS IN GLASSY MATRICES AT 77°K. Milov, A. D.; Salikhov, K. M.; Tsvetkov, Y. D. (Institute of Chemical Kinetics and Combustion, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.–Solid State 14: No. 8, 1956-1960 (Feb 1973).

The concentration dependence of spin-lattice relaxation kinetics of hydrogen atoms in aqueous solutions of sulfuric acid gamma-irradiated and frozen at 77°K and in fused quartz gamma-irradiated at 77°K has been studied by the electron spin-echo method. At low hydrogen concentrations the spin-lattice relaxation kinetics is nonexponential and indicates that the relaxation is distributed in time. At higher hydrogen concentrations the relaxation kinetics becomes exponential because of spin diffusion. The most probable rate of excitation transfer from spin to spin was determined and its dependence on spin concentration and on the width of ESR spectrum components was studied. The most probable rate of excitation loss from an isolated spin was calculated on the basis of the perturbation theory and was found to agree with experimental data on the nature of the concentration dependence and of the width of ESR spectrum components as well as with experimentally observed absolute values. (auth)

22103 EFFECT OF RADIATION WITH FAST NEUTRONS ON THE SATURATION REMANENCE OF A BASALT. Soffel, H. (Univ., Munich). Z. Geophys.; 37: 519-523(1971).

The saturation remanence $J_{sat.rm.}$ of a basalt sample from Rauher Kulm (Germany) containing homogeneous and mostly multidomain titanomagnetites and its decrease with ac demagnetization up to 700 Oe effective field was measured before and after radiation with fast neutrons (1 to 10 MeV) with a flux density of 2×10^{12} n/cm^2. With the exception of the ac demagnetization range from 0 to 10 Oe, where $J_{sat.rm.}$ after irradiation was about 1% larger than before, no change of the demagnetization curves could be detected. This suggests that essentially higher flux rates of fast neutrons or other particles are necessary to produce an appreciable increase of the coercive force of titanomagnetites in basalts and to contribute to a "hardening" of viscous remanent magnetization. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

22104 (BARC/I-165, pp 7-15) INSTRUMENTAL TECHNIQUES FOR ACCOUNTING OF NUCLEAR MATERIALS IN REPROCESSING PLANTS. Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Various instrumental techniques that are in use at different stages of development for accountability purposes in fuel reprocessing plants are briefly reviewed. They are divided into three categories, namely, in-line instruments, on-line instruments, and partially automated instruments. Gamma hull monitors, neutron hull monitors, waste drum gamma scanners, and waste drum neutron scanners are partially automated instruments used for accountability purposes. Automation of mass spectrometers, automation of x-ray fluorescence spectrometers, waste monitoring, and gamma absorptiometry are techniques under development which have promise for accountability measurements. Instrumental techniques which merit evaluation for application in accounting are coulometry, potentiometry, gamma-ray spectrometry, atomic absorption spectroscopy, and differential colorimetry. A research and development program has been initiated recently in the Fuel Reprocessing and Radiochemistry Divisions of Bhabha Atomic Research Center, Bombay, for the accounting of fissile materials in view of the materials that will be produced and handled in the nuclear power stations and associated facilities planned by the Department of Atomic Energy, India. (INIS)

22105 (BARC/I-165, pp 17-27) MASS SPECTROMETRIC TECHNIQUES IN FISSILE MATERIAL ACCOUNTING AND MANAGEMENT. Mathews, C. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Determination of plutonium in the dissolver solution of a reprocessing plant is carried out by isotope dilution coupled with mass spectrometry. A known amount of a tracer ^{242}Pu is added to an aliquot of the dissolver solution and $^{239}Pu/^{242}Pu$ ratio in this mixture is measured. This method is not affected by chemical processing and impurities present in the dissolver. It is shown that sampling and volume measurements are the contributors to the error in the determination of plutonium in dissolver solutions. A method for determining the total plutonium without resorting to any volume measurement is developed. Independent cross-check on the plutonium input to a reprocessing plant is made by establishing a relationship between ^{235}U depletion and plutonium content. Plutonium input is estimated to an accuracy of 1%. The method of determination of the in-process inventory of a reprocessing plant is also explained. (INIS)

22106 (BARC/I-165, pp 29-44) REVIEW OF ANALYTICAL METHODS USED FOR ACCOUNTING URANIUM AND PLUTONIUM IN PROCESS STREAMS AND END PRODUCTS IN THE FUEL REPROCESSING PLANT AT TROMBAY. Nadkarni, M. N.; Chitnis, V.; Venkatasubramanian, V.; Nair, G. M. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Various analytical schemes in use in the reprocessing plant of the Bhabha Atomic Research Center, Bombay, for the purpose of accounting of fissile materials are reviewed. The input accountability control involves the determination of uranium and plutonium in the dissolver. Measurement of uranium concentration in the process stream is carried out by thiocyanate spectrophotometry which involves a measurement of the absorption of thiocyanate complex of uranium. The radiometric method is adapted for the measurement of plutonium concentration in the dissolver. Output accountability control involves determination of uranium and plutonium in the respective tail end streams or products. Uranium concentration methods are the reduction of U(VI) by Ti(III) ion and reduction with Fe(II) ions. The method followed for final titration in the reduction with Ti(III) are indication titrimetry or potentiometry or derivative potentiometry. Amperometry or indicator titrimetry are the two methods followed for the final titration in reduction with Fe(II). Controlled potential coulometry is used for the determination of plutonium following oxidizing titration potentiometry, reducing titration amperometry and indicator titrimetry. (INIS)

22107 (BARC/I-165, pp 45-52) DETERMINATION OF THE PURITY OF FISSILE MATERIALS BY EMISSION SPECTROGRAPHIC TECHNIQUES. Joshi, B. D.; Dhumwad, R. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Methods developed at the Radiochemistry and Fuel Reprocessing Divisions of BARC for impurity estimation in plutonium based on chemical separation of impurities and their spectrographic determination using a dc arc are reported. Results obtained for common impurities are given. It is shown that majority of the elements can be analyzed at less than 1 ppM concentration. The influence of large quantities of common impurities like calcium, magnesium, iron etc. on the estimation of rare earths was studied. The carrier distillation method is used for estimation of many elements in high-purity uranium. Sixty three elements including rare earths can be analyzed in uranium at the concentrations of 0.01 to 5 ppM. The analysis time is about four days. The standard deviation is on an average 15%. (INIS)

22108 (BARC/I-65, pp 53-56) NUCLEAR MATERIAL MANAGEMENT IN REPROCESSING PLANT AT TROMBAY. Singhal, A. N. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Handling and accountability of uranium and plutonium in the reprocessing plant at the Bhabha Atomic Research Center, Trombay, India, are reported. Two type of commodities i.e., natural/depleted uranium which forms the bulk of the material and has low financial value and plutonium in small quantity but of high economic value, are to be accounted. Initial inventory or the plant hold-up at the start of the inventory period, input to the plant, output from the plant, closing inventory or hold-up in the plant, known losses of the material, amount of materials which could not be accounted either in the losses or under any of the above heads, the percentage of recovery and the percentage of MUF, are checked for the purpose of accountability. (INIS)

22109 (BARC/I-165, pp 57-67) CONTROL PROCEDURES PROPOSED FOR FISSILE MATERIAL ACCOUNTING IN POWER REACTOR FUEL REPROCESSING PLANT AT TARAPUR. Nair, M. K. T. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Procedures considered adequate to keep the material unaccounted for to a minimum in the power reactor fuel reprocessing plant under construction at Tarapur, India, are described. The nuclear material management group and nuclear material management review group will exercise control over the flow of nuclear materials, even interrupting the operations, if necessary. The functions and duties of the two groups are enumerated and explained. It is concluded that sub-division of the plant into various material balance areas for operational control and accounting purposes facilitates the location of the area from where any measured loss has taken place which, in turn, helps to take remedial action against future recurrance. (INIS)

22110 (BARC/I-165, pp 69-76) EXPERIENCE IN ACCOUNTING FOR PLUTONIUM IN THE RECONVERSION LABORATORY OF THE FUEL REPROCESSING DIVISION. Laxminarayanan, T. S. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Processes adopted in accounting for plutonium in the reconversion laboratory of the Fuel Reprocessing Division of the Bhabha Atomic Research Center, Bombay are described. Problems encountered during the operations and the limitations of the processes involved are discussed. Estimation of the plutonium solution received from the process section is done by alpha counting and by precipitation as oxalate. Independent determinations are carried out and results checked to agree within 1%. The accumulated waste solutions containing less than 5 mgm/liter of Pu are sent to the waste treatment section for processing. Solid waste arising during the operations is converted to plutonium oxide and analyzed. Extreme care is taken not to lose even milligram quantities of plutonium in the wastes. Due to the absence of an absolute standard for plutonium accounting, accepted methods such as (1) alpha counting, (2) coulometry, and (3) average value of coulometry and redox titrimetry obtained by independent analysis have been adopted. A typical accounting campaign in the plutonium reconversion laboratory is presented. The laboratory has been able to account within 0.32% of the amount received. Methods for improving the accuracy in accounting are suggested. (INIS)

22111 (BARC/I-165, pp 77-88) INVENTORY OF NUCLEAR MATERIAL IN THE URANIUM METAL PLANT. Jogdeo, S. M.; Inamdar, P. D. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

The Uranium Metal Plant, Trombay, India is divided into five compartments to safeguard the purity of refined uranium metal and reactor-grade uranium dioxide that are produced from crude uranium tetrafluoride and magnesium diuranate concentrates. The compartments are: (1) complexing and concentrate dissolution, (2) solvent extraction section, (3) ammonium diuranate (ADU) precipitation and calcination, (4) dust-proof area, and (5) recovery section. Procedures for recording the details in each section are given. The percentage unaccounted loss for the last seven years in the plant is tabulated. (INIS)

22112 (BARC/I-165, pp 89-97) PROPOSED MATERIAL MANAGEMENT PROGRAMME FOR THE ENRICHED URANIUM OXIDE PLANT AT NUCLEAR FUEL COMPLEX, HYDERABAD. Pande, B. P.; Prasad, K. R. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

A detailed account of the materials management program proposed for the enriched uranium plant at the Nuclear Fuel Complex, Hyderabad, is given. The objectives of the program are: (1) to minimize the material units to be accounted for, (2) to establish separate records for each major plant area and linking these in a manner that permits isolation of differences with a minimum of effort, (3) to integrate the maximum number of controls into the minimum number of records to eliminate duplication, and (4) to include a sufficient number of error checks to ensure reliability. Anticipating future safeguard requirements, the enriched uranium plant is so designed that the entire plant is well defined into four distinct sections. These sections, are (1) UF_6 section, (2) make-up section, (3) recycle section, and (4) ADU section. The sections are briefly described. Each section forms a separate accounting unit. A procedures manual to be finalized will give detailed information to identify all control points in the processing of material and for storage of raw material as well as finished product. The records to be maintained by the material control group are described. The material balance of the accountability is worked out in terms of receipts, shipment, measured discards, ending inventory, and loss. The management program attempts to bring down MUF within tolerable limits. (INIS)

22113 (BARC/I-165, pp 99-119) RAPID NONDESTRUCTIVE ESTIMATION OF URANIUM AND U-235 BY GAMMA ACTIVITY MEASUREMENTS. Chakraborty, P. P.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Investigations on short-lived ^{235}U fission product gamma activity cooled for 0.4 s were carried out. A rabbit-type pneumatic sample transport facility was used for irradiation of samples. An automatic electronics system was used to record time of irradiation, travel, and counting of samples. The characteristic of short-lived activities ($T_{\frac{1}{2}} \sim 5$ s) were analyzed and employed for rapid nondestructive analyses of uranium in ores and compounds and ^{235}U in depleted uranium from the processing plant and enriched uranium. A serious limitation of this method arises from the high radiation background in a reactor hall. The method does not identify fissile materials. (INIS)

22114 (BARC/I-165, pp 121-144) NUCLEAR MATERIAL ACCOUNTING IN FUEL FABRICATION PLANTS. Rao, N. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Procedures developed for accounting controls in fuel fabrication plants where uranium and thorium are processed, are reported. This study assumes that the accounting starts when the fuel materials are received at the fabricating plants and ends when the materials are shipped as fuel assemblies to reactors. Monthly material balance sheets for the uranium metal, natural UO_2, depleted UO_2, uranium carbide, thorium metal and thorium oxide are presented. (INIS)

22115 (BARC/I-165, pp 145-151) FISSILE MATERIAL ACCOUNTABILITY PROBLEM ASSOCIATED WITH THE PLUTONIUM FUEL FABRICATION WORK AT BARC. Roy, P. R.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Operations involved in the fabrication of fuel at the plutonium laboratory of the Radiometallurgy Section, Bhabha Atomic Research Center, Trombay, India are reported. The problems associated with the handling of plutonium material losses in the fabrication operations, procedure for plutonium accountability are discussed. It is felt that there is need to develop good techniques of accountability by developing statistical methods of sample preparation and accurate techniques for the estimation of plutonium. (INIS)

22116 (BARC/I-165, pp 153-157) FISSILE MATERIAL MANAGEMENT PROBLEMS IN FUEL PRODUCTION PLANT AND RADIOCHEMICAL RESEARCH. Janardhanan, S.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Fissile material accounting from the point of view of radiation hazards and criticality considerations in radiometallurgical laboratory and radiochemistry laboratory of the Bhabha Atomic Research Center, Trombay, India, is considered. Accounting is carried out in radiometallurgy laboratory at different phases. They are: (1) receipt of green pellets, (2) sintering in argon and hydrogen atmosphere, (3) cleaning pellets, loading in pins, argon arc welding followed by leak test, and (4) loading in birdcages and storage. The different phases at which accounting is carried out in the radiochemistry laboratory are: (1) Pu or U in various chemical forms received, (2) distribution to glove boxes, (3) and preparation of source and fission chemistry work with Pu or U etc. It is concluded that the method of solid waste monitoring needs to be established and adopted for such operations. (INIS)

22117 (BARC/I-165, pp 159-175) ESTIMATION OF PLUTONIUM IN SEALED CONTAINERS: A FEASIBILITY STUDY. Janardhanan, S.; Murthy, K. B. S. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

A method for estimation of Pu in PuO_2 pellets by counting the neutrons emitted by them was developed. Proton recoil flux counters with multiple radiators and BF_3 filled annular counter are designed to count the fast neutrons emitted by spontaneous fission and (α,n) reactions from PuO_2. From the consistency of the results obtained using flux counter and the annular counter, the feasibility method of nondestructive estimation of Pu both by fast neutron counting and thermal neutron counting are established. It is necessary to use reference standard PuO_2 sample for calibration work and routine application to an estimation of Pu in pure PuO_2 samples. (INIS)

22118 (BARC/I-165, pp 177-183) ESTIMATION OF ^{235}U AND ^{239}Pu IN A MATRIX: A FEASIBILITY STUDY. Iyer, M. R.; Chakraborty, P. P. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Investigation of composite fission product gamma spectrum for ^{235}U (n_{th}, F) and ^{239}Pu (n_{th}, F) at short times after fission was undertaken using 3″ × 3″ NaI (Tl) crystals, in order to find out if any special signatures of fissile materials from the spectrum could be obtained. The experimental set-up mainly consists of a fast pneumatic sample transfer assembly, an electronic system for recording, and a 512 channel analyzer. Because of the poor resolution of the detector, it was difficult to arrive at any specific fission signature from the two spectra for ^{235}U and ^{239}Pu, but it was possible to arrive at certain guide lines for the identification of the fissile materials by studying the behavior of the gamma activity in difficult energy channels. (INIS)

22119 (BARC/I-165, pp 185-190) FISSILE MATERIAL ACCOUNTING FOR TARAPUR REACTORS. Dayal, M.; Chakraborty, P. P. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

A computer program, FLARE has been used to compute the three dimensional exposure and void distributions in the reactor cores of the Tarapur Power Reactors. The exposure and void distribution output from FLARE is fed as input to a program TAPSICAP, evolved at Tarapur. This program evaluates in each bundle, isotopic composition at different axial levels and the inventory of each isotope in the whole core. A flowchart illustrating the link between the two programs is also given. The form of reports which give an idea of inventory, nuclear loss, and production at a glance including locations are presented. (INIS)

22120 (BARC/I-165, pp 203-207) FISSILE MATERIAL AUDITING. Mathews, C. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Some aspects of nuclear material auditing as it is practiced in the USA are discussed. Auditing of individual facilities and material balance in the fuel cycle as a whole, are analyzed. Laboratory measurements support the auditing by supplying standards that are required to evaluate the accuracy of measuring methods and practices. Members should be specialized in measurements, statistics, accountancy and auditing with a broad background of the nuclear fuel cycle. Cost involved in auditing is also mentioned. (INIS)

22121 (BARC/I-165, pp 209-213) AUDITING OF PLUTONIUM IN PLUTONIUM OXIDE LOTS PRODUCED AT FUEL REPROCESSING DIVISION. (Bhabha Atomic Research Centre, Bombay). 1972.

From seminar on accountability and management of fissile materials; Trombay, India (13 Apr 1971).

Studies were made at Radiochemistry Division (RCD) and Fuel Reprocessing Division (FRD) of the Bhabha Atomic Research Center, Bombay, India, to standardize accurate and reliable methods for the estimation of plutonium. The potentiometric method was developed and employed at RCD while the coulometric and volumetric methods were tested and used at FRD. The potentiometric and coulometric methods were found to have their accuracy within the precision of the methods (better than 0.2%) while the volumetric method of estimation was found to have an accuracy within 0.5% of the expected value. Each audit sample was analyzed by potentiometry at RCD and by coulometry at FRD. Neither of the methods used, showed any systematic variation indicating that the impurities present in plutonium samples do not affect the results to any significant extent. Based on the results, the plutonium content of each sample analyzed could be known within ±0.5% at 95% confidence level. (INIS)

22122 (GULF-RT-A-12279) APPLICATION OF PHOTO-INDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report, April 1–June 30, 1972. Bramblett, R. L.; Costello, D. G.; Ginaven, R. O.; Naliboff, Y. D.; Rundquist, D. E. (Gulf Radiation Technology, San Diego, Calif.). 3 Apr 1973. Contract AT(04-3)-167. 33p. Dep. NTIS $4.00.

Research and development activities performed by Gulf Radiation Technology during the reporting period on techniques and applications of nondestructive measurement of nuclear materials are reported. The mobile assay system (GAMAS), completed field operations at the Bettis Atomic Power Laboratory (BAPL), and then performed further field operations at Goodyear Atomic (GAT) in Piketon, Ohio, and Mound Laboratories in Miamisburg, Ohio. The Isotopic Source Assay System (ISAS) Unit 3 was sent to BAPL and then to the Westinghouse Astronuclear Plant in Pittsburgh, to assist the AEC Chicago Operations Office in their close-out inventory, before continuing on to GAT and Mound. (auth)

22123 (K-1839(Pt.2)) BEHAVIOR OF THE URANIUM ISOTOPES IN SEPARATION CASCADES. Part II. A Short Cascade Designed for the Production of Power Reactor Fuel. Blumkin, S.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 29 Aug 1973. Contract W-7405-eng-26. 61p. Dep. NTIS $5.45.

This is the second part of a study directed at assessing the usefulness of measurements of the concentrations of the minor uranium isotopes in cascade feed and withdrawal streams as a complementary safeguards technique for ^{235}U enrichment plants. An efficient multisection (squared-off) gaseous diffusion cascade was designed for the production of power reactor grade uranium having a ^{235}U content of 4% ^{235}U. The behavior of the ^{234}U, ^{235}U, and ^{236}U concentrations in this cascade and the cascade performance have been examined for a variety of external stream flow rates and isotopic concentrations. It is shown that the content of both ^{234}U and ^{236}U relative to that of ^{235}U in the cascade withdrawal streams is affected significantly by changes in these operating conditions even when the conditions are chosen such that the ^{235}U content of these streams is maintained constant. This indicates that the measurements of the ^{234}U and ^{236}U concentrations in addition to that of ^{235}U in the feed and withdrawal streams of an enrichment cascade have some potential as a safeguards technique. (auth)

Disposal and Storage

Refer also to abstracts 20862, 21060, 21272, and 23875.

22124 (AEC-tr-7441) CONDITIONS FOR THE STORAGE OF WEAKLY RADIOACTIVE WASTES IN THE ASSE SALT MINE. Status: July 1971. (Gesellschaft fuer Strahlen- und Umweltforschung M.B.H., Munich (West Germany)). Jul 1971. Translation of a German Paper. 12p. Dep. NTIS $3.00.

Packaging requirements and radioactivity limitations for weakly radioactive wastes to be acceptable for storage in the Asse Salt Mine are given. (TFD)

22125 (AEC-tr-7442) PROVISIONAL CONDITIONS FOR THE TRIAL STORAGE OF MEDIUM RADIOACTIVE WASTES IN THE ASSE SALT MINE. Status: September 1972. (Gesellschaft fuer Strahlen- und Umweltforschung M.B.H., Munich (West Germany)). Sep 1972. Translation of a German Paper. 11p. Dep. NTIS $3.00.

Packaging requirements and radioactivity limitations for medium radioactive wastes to be acceptable for storage in the Asse Salt Mine are given. (TFD)

22126 (AEC-tr-7443) STORAGE OF WEAKLY RADIOACTIVE WASTES IN THE ASSE SALT MINE. Status: 1971. (Gesellschaft fuer Strahlen- und Umweltforschung M.B.H., Munich (West Germany)). Jul 1971. Translation of a German Paper. 2p. Dep. NTIS $3.00.

A contract form for entering into an agreement to store weakly radioactive wastes in the Asse Salt Mine is presented. (TFD)

22127 (BNWL-CC-1352) GROUND DISPOSAL OF REACTOR COOLANT EFFLUENT. Eliason, J. R.; Hajek, B. F. (Battelle Pacific Northwest Labs., Richland, Wash.). 19 Sep 1967. Contract AT(45-1)-1830. 19p. Dep. NTIS $3.00.

A study in which reactor coolant effluent was disposed to an existing trench at 100-D Area was conducted for a four-month period from March to June 1967. During this time 3.367×10^9 gallons of effluent were infiltrated at an average rate of 1277 gal/day/ft^2. Groundwater elevations and temperatures increased in the vicinity of 100-D; however, no significant decrease in infiltration rate occurred. Decontamination factors ranged from 2.5 for ^{51}Cr to >276 for ^{65}Zn. These are probably minimum decontamination factors since the route followed by wastes moving from the trench to the springs is considered to be the path having the shortest travel time. Groundwater elevations quickly returned to near pre-test levels upon termination of disposal; however, groundwater temperatures are decreasing slowly. This study showed that large volumes of reactor coolant effluent can be disposed to the ground for significant periods of time. The decontamination achieved is probably greater than could be obtained by any other treatment process. (auth)

22128 (NRPB-R-14) MODEL FOR THE EVALUATION OF THE DEEP OCEAN DISPOSAL OF RADIOACTIVE WASTE. Webb, G. A. M.; Morley, F. (National Radiological Protection Board, Harwell (England)). Jun 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

The nature of packaged solid radioactive wastes disposed of in the deep Atlantic and the scientific and technical considerations involved in assessing the movement of radionuclides following disposal are reviewed. A model is established and used to estimate the relationship between continuous rates of disposal and the radiation doses ultimately received by those persons likely to be exposed to the greatest extent. The model takes account of oceanographic factors and the transfer of radionuclides through marine ecosystems; there are many inherent safety factors. Separate consideration is given to alpha and beta-gamma active wastes; tritiated wastes are treated as a special case. The rates of disposal corresponding to the Dose Limits set by International Commission on Radiological Protection are calculated to illustrate the concept of "limiting environmental capacity." (auth)

22129 (ORNL-4883, pp 63-64) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIVES. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

22130 (TID-3341) RADIOACTIVE WASTE MANAGEMENT. A Bibliography of Publicly Available Literature Pertaining to the USAEC's Savannah River, S. C., Production Site. (Technical Information Center (AEC), Oak Ridge, Tenn.). Aug 1973. 35p. TIC Free.

This bibliography contains abstracts of 197 technical reports and journal articles which have appeared in Nuclear Science Abstracts from Jan. 1951 through July 1973 pertaining to radioactive waste management at the Savannah River site. The abstracts are grouped into ten subject categories. Within the categories, they are arranged by NSA volume and abstract number. (TFD)

22131 (TID-3342) RADIOACTIVE WASTE MANAGEMENT. A Bibliography of Publicly Available Literature Pertaining to the USAEC's National Reactor Testing Station, Idaho. (Technical Information Center (AEC), Oak Ridge, Tenn.). Aug 1973. 56p. TIC Free.

This bibliography contains abstracts of 272 technical reports and journal articles which have appeared in Nuclear Science Abstracts from Jan. 1951 through July 1973 pertaining to radioactive waste management at the National Reactor Testing Station. The abstracts are grouped into ten subject categories. Within the

categories, they are arranged by NSA volume and abstract number. (TFD)

22132 (TID-26431) REPORT ON THE INVESTIGATION OF THE 106 T TANK LEAK AT THE HANFORD RESERVATION, RICHLAND, WASHINGTON. (Richland Operations Office (AEC), Wash.). Jul 1973. 129p. RLO Free.

The events leading up to and the results of the 106 T tank leak at HAPO are discussed. (TFD)

22133 (WASH-1202(73)) PLAN FOR THE MANAGEMENT OF AEC GENERATED RADIOACTIVE WASTES. Pittman, F. K. (Division of Waste Management and Transportation (AEC), Washington, D. C.). Jul 1973. 48p. GPO $0.80.

The AEC's plans for controlling the releases of radioactivity and ensuring the safe storage of radioactive wastes generated by past, present and future operations of the AEC are presented. The basic and fundamental objective of this Plan is to handle these wastes at all times in a manner that will not endanger the health and safety of its employees or the public; will not have an adverse impact on man's environment or on the ecology; and will be accepted by the public. (auth)

22134 CONSTRUCTION OF A PROBABILISTIC MODEL OF THE DISTRIBUTION OF NUCLEAR POWER STATION WASTES VENTED TO THE AIR. Piskunov, L. I. At. Energ. (USSR); 33: No. 5, 913(Nov 1972). (In Russian).

This paper was summarized as paper No. 617/6339 with full copy held by TIC.

A probabilistic model is described that provides a more complete picture than can be obtained from calculations based on turbulent diffusion formulas. It includes stack height, wind direction and velocity, turbulent exchange, atmospheric stability, dilution and scattering of radioactive impurities, surface roughness factor, temperature inversion and calms, washout of impurities by atmospheric precipitation, and the factor of secondary contamination due to ash transport of activity over the surface. (TFD)

22135 PROCESS FOR RECOVERY AND CONTAINMENT OF RADIOACTIVE GASES. Lofredo, A.; Goldschmidt, D. H. (to Airco Inc.). U. S. Patent 3,748,864. 31 Jul 1973. Filed date 21 Jan 1969. 10p.

This invention relates to apparatus and methods for the removal and safe containment of radioactive krypton and xenon present in the air leakage stream of a nuclear plant utilizing a boiling water reactor. The invention utilizes cryogenic techniques to separate the xenon and krypton isotopes from the air and then stores the same until they are no longer a safety hazard. (Official Gazette)

22136 RADIOACTIVE WASTE MANAGEMENT PRACTICES IN WESTERN EUROPE. Paris; Organisation for Economic Cooperation and Development (1971). 126p. $3.25.

The practices applied to the management of radioactive wastes in Western Europe are reviewed. Information is presented on: characteristics of radioactive wastes; sources of wastes, i.e., nuclear power production, nuclear research, and preparation and uses of radioisotopes; safety, economic, and technical considerations related to radioactive wastes; specific practices in Western Europe for management of gaseous, liquid, and solid wastes; and the outstanding waste management problems related to high-level wastes from fuel reprocessing, long-lived alpha wastes, ^{85}Kr, tritium, and the decommissioning of nuclear power plants. It is concluded that: in spite of the complexity and magnitude of problems associated with radioactive wastes, these problems have proved manageable; basic standards for radiological protection derived from ICRP recommendations provide an effective means by which practices of waste management can be regulated in the public interest; continued primary concern for the human health aspects of radioactive waste management assures that ecological damage will not be significant; and the optimum development of nuclear energy need not be impeded by the waste management problems which will have to be dealt with. (LCL)

22137 CONTROL OF RADIOISOTOPE RELEASES TO THE ENVIRONMENT FROM DIAGNOSTIC ISOTOPE PROCEDURES. Moss, C. E. (Robert Morris Coll., Pittsburgh). Health Phys.; 25: No. 2, 197-198(Aug 1973).

Attention is called to the potential public health problem resulting from the rapid growth in the diagnostic use of isotopes. Prompt consideration of steps to bring these discharges under control is urged. (UK)

Handling Equipment and Procedures

Refer also to abstract 20758.

22138 (JUL-922-SB) LIMITATION OF FISSIONABLE MATERIAL IN RELATION TO STORAGE AND PROCESSING OF URANIUM-THORIUM-GRAPHITE PARTICLES OF HIGH ^{235}U ENRICHMENT. Schaffer, O. (Kernforschungsanlage, Juelich, (West Germany)). Feb 1973. 31p. (In German). Dep. NTIS (U. S. Sales Only $3.75.

Based on criticality assessments for homogenous uranium-thorium-graphite-water mixtures highly enriched with ^{235}U, the admissible quantities of uranium and heavy metals with regard to the storage and processing of uranium-thorium-graphite particle batches are derived. This is done by a two-group diffusion method, assessing minimum critical masses for a constant thorium-uranium mass ratio as a function of the particle bulk density, the carbon-uranium ratio C/U, and the water-volume ratio α, taking into account a thick reflector made of gravel concrete. The results of the numerical calculations are discussed and the basic principles of the calculating method are explained. The group parameters and input data used are given in tables. The accuracy and suitability of the method are shown by comparing the results with the data for special cases published in the available literature. (GE)

22139 (RFP-2027) TEST PROCEDURES FOR THE NEUTRON CRITICALITY ALARM SYSTEM AT ROCKY FLATS PLANT. Tyree, W. H. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 2 Aug 1973. Contract AT(29-1)-1106. 35p. Dep. NTIS. $4.00.

Test procedures are described of the Criticality Alarm System in use at the Rocky Flats Plant in Golden, Colorado. The purpose of the alarm system is to detect high levels of neutron radiation. To assure effective use of the system in setting up operating parameters, circuit drawings together with photographs show component labels, controls, and related equipment units. All data have been taken from prepared Dow Drawings, Series No. 11962. Included are details of the electronics and radiation tests required to insure reliable alarm operation of the criticality detection system and interfaces. (auth)

22140 (RFP-Trans-136) INCIDENTS AND ACCIDENTS DUE TO ELECTRICITY IN VERY HIGH ACTIVITY CELLS. Prevention and Combating Methods. Roussel, E.; Mansard, B.; Mangeot, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. Translation of IAEA Paper SM-125/20. 11p. Dep. NTIS $3.00.

The origin of fires in very high activity cells can be very varied and some of these are listed as examples. In the design of the cells, prevention of fires is first considered in the selection of construction materials, and then in the installation of fire detectors and fire fighting equipment. The detection methods used in the cells themselves and below the cell filters are outlined. The fire fighting methods consist of extinction products used in the cells, particular arrangements of the cells and extraction circuits, insulation devices mounted on the extraction circuits, use of special containers, and periodic retraining of the laboratory personnel. Each of these is described. The procedure followed after the detection of a fire at various locations in the cell is given. A periodic testing of the installations is made to ensure their reliability. The emphasis in fire fighting is its containment within the cell so that no contamination outside of the hot cell occurs. An abstract prepared for the publication in the original language appeared in NSA as Abstract No. 24:20966. (CH)

22141 CRITICALITY SAFETY OF PIPE INTERSECTIONS FOR PLUTONIUM NITRATE SOLUTIONS. Rueckert, N. T.; Thomas, W. (Technische Univ., Munich). Atomkernenergie; 21: No. 3, 197-202(1973). (In German).

In chemical processing of fissile solutions, pipe intersections of complex geometry occur at various points of the process as evaporators, absorption washers, and pipe connections of storage columns. Criticality safety of these intersections is rather difficult to be assessed. For plutonium nitrate solutions, some simple models of intersection have been calculated by Monte Carlo Method for various reflector conditions. The computational method is checked against experiment. From the results, parameters for simpler methods of criticality control have been derived (Generalized Equivalent Cylinder- and Generalized Area of Intersection Methods). A k_{eff} of about 0.85 has been taken as basis for safe parameters. (GE)

22142 OUTLINES OF THE MHI HOT LABORATORY. Susukida, H.; Ando, T. (Kobe Technical Inst., Japan). Tech. Rev., Mitsubishi Heavy Ind.; 10: No. 2, 99-109(Jun 1973).

Mitsubishi Heavy Industries, Ltd., built a hot laboratory at Tokai-mura in October 1972 for the purpose of performing surveillance tests of the steels for nuclear reactor vessels, radiochemical experiments, and research and development of materials for nuclear reactors. This hot laboratory consists of a material testing area and a radiochemical experimenting area. The former

is composed of a heavy concrete cell and seven lead cells. The maximum radioactivity (as ^{60}Co) which can be handled in the heavy concrete cell and lead cell are ^{100}Ci and ^{9}Ci, respectively. Equipped in the cells are various kinds of facilities which can be used for the disassembling of the capsule, tensile testing, fracture toughness testing, Charpy impact testing, microscopic observation, hardness testing, and heat treatment. The facilities in the cells can be remote-controlled from the operation area by means of manipulators and tongs. (auth)

22143 DECONTAMINATION AND DEMOLITION OF DISUSED BUILDINGS CONTAMINATED WITH RADIOACTIVITY. 1. Practical Aspects. Binns, K. C. (National Radiological Protection Board, Sutton, Eng.). Radiol. Prot. Bull.; No. 4, 16-19(Jul 1973).

A brief outline is presented of some of the practical problems arising from the demolition and radioactive decontamination of disused buildings. The following problems are mentioned as being special to such demolition: the possibility of large areas of rough ground to be surveyed; the porosity of brickwork and the distribution in depth of activity; the dangers of fixed activity becoming airborne during demolition; salvage of structural materials and minimization of disposal costs; methods of monitoring bulk material quickly to avoid delay of vehicles and digging equipment; and safety, with regard to the responsibility for subcontractors personnel, and tasks to be undertaken by the National Radiological Protection Board. These problems are illustrated by an example concerning the demolition of a 19th century house which had been used for luminizing work and converted back to residential use, prior to a housing development scheme. The final estimate of ^{226}Ra activity in house and garden was 50 mCi. (UK)

Transportation

Refer also to abstracts 21058 and 21455.

22144 PERMISSIBLE SCOPE OF LICENSING CONDITIONS FOR THE TRANSPORT OF NUCLEAR FUEL. Altmann, J.; Blechschmidt, M.; Fredrich, H. J. (Physikalisch Technische Bundesanstalt, Brunswick). Atomwirt., Atomtech.; 18: No. 7, 337-338(1973). (In German).

The regulation on the transport of dangerous sea goods does not apply, or at least partly, to ships under foreign flags which put into a port of the German Federal Republic solely for unloading or for a stay. One case in particular leads to the question whether the rules for the licensing of the transport of nuclear fuels on the basis of the German Atomic Law could also be specified in this case as conditions in the atomic legal licensing process according to Par. 17 of the Atomic Law. This would be in accord with the sense and purpose of the Atomic Law. (GE)

22145 CONTAINER FOR RADIOACTIVE SUBSTANCES. Baatz, H.; Colhoun, C.; Pfeifer, W. (to Transnuklear GmbH). German Patent 1,908,000. 20 Aug 1970. Filed date 18 Feb 1969. (In German).

A container for radioactive material, especially of fuel elements, is described which is characterized by the fact that an internal supplementary container which is closed on its side by a clamp fastening is introduced into an external container consisting of two cylindrical bodies separated by an insulating material. (tr-auth)

22146 DEVICE FOR ENCAPSULATING A RADIOACTIVE RESIN-WATER SLURRY. Kucherer, H. D. U. S. Patent 3,749,917. 31 Jul 1973. Filed date 12 May 1971. 4p.

A device and process is described wherein a metallic drum is lined with a layer of cement and vermiculite and evacuated. An injection header is fitted to and extends into the hollow interior of the lined drum to permit access of radioactive waste comprising a resin-water slurry. The hollow interior of the drum may fill with resins while the cement-vermiculite layer uniformly absorbs the water. (Official Gazette)

22147 SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL. Peterson, R. W. (to NL Industries, Inc.). U. S. Patent 3,731,102. 1 May 1973. Filed date 24 May 1971. 4p.

A shipping container is described that includes inner and outer shells having radiation shielding between the shells and including a radioactive material receiving central cavity which is filled with liquid coolant during shipment. Expansion means in the form of an annular tank is disposed in a void defined between the shielding and the outer shell, this tank receiving liquid coolant from the cavity when the coolant expands upon an increase in temperature thereof and returning coolant to the central cavity when the coolant contracts upon a decrease in temperature. (Official Gazette)

22148 SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL. Peterson, R. W.; Backus, H. A.; Anderson, C. J. (to NL Industries, Inc.). U. S. Patent 3,731,101. 1 May 1973. Filed date 14 Apr 1971. 8p.

A shipping container is described that includes an inner shell and an outer shell spaced outwardly of the inner shell, and radiation shielding material being disposed within the space between the inner and outer shell. The inner shell defines a radioactive material receiving cavity having a cross-sectional configuration defining three sides, adjacent ones of the sides joining one another to define three apexes to thereby provide maximum capacity with a minimum size and weight container. (Official Gazette)

22149 SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL. Peterson, R. W. (to National Lead Co.). U. S. Patent 3,732,423. 8 May 1973. Filed date 24 May 1971. 4p.

A shipping container is described that includes inner and outer shells having radiation shielding between the shells and defining gaps at the interfaces between the shielding and the shell. A method is provided in said gaps having a thermal conductivity which is substantially greater than that of air and which inhibits corrosion of the radiation shielding. A method is also provided for releasing the contents in said gaps into the cavity within the body at a predetermined temperature. (Official Gazette)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 22498 and 22960.

22150 (CEA-CONF-2346) RECENT DEVELOPMENTS AND PROJECTS AT THE SACLAY'S 600 MeV ELECTRON LINAC. Aune, B.; Juillard, M.; Netter, F. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 4p. (CONF-730310-61). Dep. NTIS (U. S. Sales Only) $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

High power runs (> 150 kW average in the beam) and very high resolution beam handling ($\Delta E/E = 10^{-4}$) are described. A new assembly for producing high intensity positions was tested, and a new standing wave section for the first acceleration of the positrons is under construction. A pulsed magnet giving alternately beams in two rooms with 10 ms switching time is under completion. Studies now under way include improvements of the beam emittance, increase of the maximum duty cycle (25 μs at 1000 Hz instead of 10 μs at 2000 Hz), automatization of some functions in the beam handling systems and in the linac itself, more generalized alternate beam switching and also division of the linac in a low energy part (200 MeV e^- or 100 MeV e^+) and a high energy part (400 MeV e^-) operating simultaneously with a second injector located at the low energy station. Projects under investigation include attempts to use separately two simultaneous beams at different energies coming from two injectors or from the selection of some 3 GHz bunches by a section operating at 1 GHz. The transformation of the linac to a superconductive one (10 MV/m) is also considered for the future. (auth)

22151 (COO-1760-6) SUMMARY REPORT ON CYCLOTRON UTILIZATION, OPERATIONAL ACHIEVEMENTS AND IMPROVEMENTS DURING TWELVE MONTHS ENDING MAY 31, 1973. Technical Progress Report. Shull, F. B. (Washington Univ., St. Louis, MO). 15 Jul 1973. Contract AT(11-1)-1760. 57p. Dep. NTIS $5.00.

The operation and utilization of the 54-inch sector-focused cyclotron at Washington University are reviewed. The normal bi-weekly schedule, monthly actual use, breakdown of beam hours by ion type, total hours used by Chemistry Department researchers, and particle energies and some maximum currents in the main target chamber are tabulated. Improvement projects undertaken during the year are discussed, and the operating budget is summarized. (WHK)

22152 (ITEF-967) DESIGN CONSIDERATIONS FOR A 2,000 GeV PROTON SYNCHROTRON, THE "TEVATRON". Vladimirskii, V. V.; Koshkarev, D. G.; Stadnikov, A. G.; Barkhudaryan, A. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Considerations on an accelerator complex to produce peaks of protons and antiprotons at energies up to 2,000 GeV and peaks of secondary particles of all sorts in a wide range of pulses from 0 to 1600 GeV are discussed. The possibility of the transfer of the principal accelerator to cryogenic magnets is considered. The project can be realized in two stages. In the first, the linear accelerator, the first and second booster, and part of the experimental hall for work with peaks up to 200 GeV are constructed. The basic parameters of the accelerator complexes are reported. (tr-auth)

22153 (LBL-1659) PROGRESS WITH THE SUPERHILAC. Ghiorso, A. (California Univ., Berkeley. Lawrence Berkeley Lab). Mar 1973. Contract W-7405-eng-48. 10p. (CONF-730310-60). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Difficulties encountered in the design and construction of the SuperHILAC are briefly described, and the status of the machine is outlined. (WHK)

22154 (LBL-1666, pp 372-373) 88-INCH CYCLOTRON OPERATION AND DEVELOPMENT. Bowen, J.; Clark, D. J.; Frazier, P.; Morris, D. May 1973.

In nuclear chemistry annual report, 1972.

22155 (LBL-1666, pp 373-376) ACCELERATORS FOR NUCLEAR PHYSICS. Clark, D. J. May 1973.

In nuclear chemistry annual report, 1972.

22156 (LBL-1698(Rev.)) CONSIDERATIONS OF BEAM QUALITY REQUIREMENTS FOR EXPERIMENTS WITH VERY HEAVY IONS. Alonso, J. R.; Harvey, B. G. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-Eng-48. 32p. Dep. NTIS $4.00.

Factors that limit the attainable resolution in certain heavy-ion experiments are examined. It has been argued that beam quality from accelerators such as the SuperHILAC will often prove to be a very serious limitation. It is shown that other, purely experimental factors are likely to impose considerably more severe limitations. The emphasis is placed on particle spectroscopy experiments because of the tremendous popularity and success of this technique in recent years, and because such experiments probably place the most severe requirements on beam quality. However, future experiments in heavy-ion physics may well be based mainly on differently techniques, with less severe beam quality requirements. Some beam properties of existing heavy-ion accelerators at LBL are discussed, and some of the experimental problems which may be considered are detailed. (auth)

22157 (NP-19819) IPCR CYCLOTRON PROGRESS REPORT, 1972. Volume 6. (Institute of Physical and Chemical Research, Wako (Japan)). Dec 1972. 146p.

Topics discussed include machine operation and development, accelerator physics, nuclear physics research (scattering, nuclear reactions, and spectroscopy), nuclear instrumentation, radiochemistry, radiation chemistry and radiation biology, solid state physics, production of radioisotopes for medical use, and radiation monitoring. Publications, personnel, and outside users are listed. (WHK)

22158 ELECTRON LINEAR ACCELERATORS IN FUNDAMENTAL RESEARCH IN RADIATION BIOLOGY. Kiefer, J. (Univ., Giessen, Ger.). Kerntechnik; 15: No. 5, 219-226(1973). (In German and English).

The possibilities offered by electron linear accelerators for the study of radiobiological and radiochemical processes are discussed. Typical research problems and concepts of radiation biology are discussed, and a distinction is drawn between five different phases of radiation damage. The processes studied are not only important in radiation biology as such but may also have direct consequence in radiotherapeutic practice. (GE)

22159 TRANSIENT AND STATIONARY TEMPERATURE RISE OF THE ACCELERATING STRUCTURE IN ELECTRON LINACS. Irie, K. (Mitsubushi Electric Corp., Tokyo). Jap. J. Appl. Phys.; 11: No. 1, 76-81(Jan 1972).

Temperature equations which describe temperature distribution along the accelerating structure as a function of time are solved in some special but practical cases on traveling wave electron linacs. The time constant of temperature rise of the accelerating structure is about 20 seconds and the saturated temperature rise is about 2°C in usual S-band linacs for radiography and medical therapy. Also the temperature gradient along the accelerating structure is discussed and its effects on performances of electron linacs are shown to be small. (auth)

22160 TECHNICAL ASPECTS AND APPLICABILITY OF A LINEAR ACCELERATOR. Calamini, A. (Mueller GmbH, Hamburg). Roentgenpraxis; 26: No. 6, 142-148(1973). (In German).

The principle and mode of operation of a traveling wave electron linear accelerator is described. The apparatus is constructed in such a way as to be of particular use in radiotherapy. The electrons, accelerated to 8 MeV, can be used directly or converted into bremsstrahlung. (GE)

22161 STATUS OF CONSTRUCTION AND EXPERIMENTAL PROGRAM FOR THE LOS ALAMOS MESON PHYSICS FACILITY. Rosen, L. (Los Alamos Scientific Lab., NM). Kerntechnik; 15: No. 7, 319-324(1973).

A novel accelerator facility is nearing completion at the Los Alamos Scientific Laboratory. It is based on a variable energy proton linac, of 800-MeV maximum energy and capable of providing 800 MW of beam power. The facility is designed to explore nuclear and subnuclear phenomena with intense, high-quality beams of nucleons, pions, muons and neutrinos. The facility will also be applied to practical purposes in medicine, radionuclide production, and nuclear reactor development. (GE)

22162 ELECTRON LINEAR ACCELERATORS FOR RADIATION THERAPY: HISTORY, PRINCIPLES, AND CONTEMPORARY DEVELOPMENTS. Karzmark, C. J.; Pering, N. C. (Stanford Univ., CA). Phys. Med. Biol.; 18: No. 3, 321-354(1973).

The evolution of particle accelerators is most often associated with the development of two circular machines, the cyclotron for heavy particles and the betatron for electrons. What is not so often recognized is that linear particle accelerators were developed concomitantly. These latter machines constitute the historical antecedents of the modern, microwave-powered electron linear accelerator (or linac) now widely used for x-ray and electron radiation therapy. This review describes these linear precursors and develops the microwave basis for both power generation and electron acceleration. In addition, the technical features of historically significant treatment units are reviewed and contemporary developments are described. (TFD)

Auxiliaries and Components

22163 (BNL-18025) SHIELDING MEASUREMENTS: 200-MeV LINAC. Distenfeld, C. H. (Brookhaven National Lab., Upton, N. Y.). 10 Jul 1973. 17p. (CONF-730603-11). Dep. NTIS $3.00.

From 18th health physics society meeting; Miami Beach, Florida, USA (17 Jun 1973).

The start-up survey of the Brookhaven 200 MeV proton linac isotope production facility, BLIF, revealed that the shield offered more attenuation than expected. Shielding consists of a water filled stainless steel tank buried in sand and filled to about 32 feet above the proton target point. The proton beam, nominally 10^{15} sec^{-1}, projects horizontally across a part of the 8 foot diameter tank, thus establishing a transverse orientation between beam direction and water shield. Experimental results indicated about $^1/_4$ less water shielding was needed to reach design leakage levels of 2.5 mrem/hr. This was due to a proton induced secondary neutron spectrum devoid of significant components above about 80 MeV. The design spectrum was harder and therefore more penetrating than the real spectrum, which had a measured attenuation length of 58.2 cm. Additional study is needed to explain the presence of this significantly softer transverse secondary neutron spectrum. The study should have practical implications for future shielding design. (auth)

22164 (BNL-18036) VERTICAL AND HORIZONTAL POSITION SENSING OF UNBUNCHED BEAMS. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 12 Jul 1973. 4p. Dep. NTIS $3.00.

A method of sensing the vertical and horizontal position at many azimuthal points of the unbunched proton beams that exist in storage rings using magnetic probes is examined and found to be practical. (auth)

22165 (CEA-N-1600, pp 126-127) OPTICAL BEAM DETECTOR FOR 1 GeV SPECTROMETRY. Durand, J. M.; Lugol, J. C. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971-September 30, 1972.

An optical method was used to detect and measure the intensity of the 1-GeV beam from Saturne. (auth)

22166 (CEA-N-1600, pp 199-201) AUTOMATION OF THE ACCELERATOR OPERATION. Mauffre, B.; Roland, S. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971-September 30, 1972.

The configuration of the automatic control system of the Saclay linear accelerator is described. The utilization of thin foils enabled the two lobes of the transition radiation predicted by the theory to be observed. Studies of the amplitude and the form of these lobes permit the position and energy of the electron beams to be rapidly controlled. (FR)

22167 (RL-73-58) POSSIBLE HAZARDS ARISING FROM THE USE OF COBALT-IRON IN THE 70 MeV INJECTOR. Elliott, R. T.; Flower, P. S. (Rutherford High Energy Lab., Chilton (England)). May 1973. 4p. Dep. NTIS (U. S. Sales Only) $3.00.

The use of cobalt in the pole-tips of magnets for the 70 MeV injector for NIMROD may lead to higher gamma dose rates than when iron is used. Dose rates are compared for cobalt, iron and copper, for direct bombardment by 10 MeV protons, and by fast, epithermal and thermal neutrons. (UK)

22168 AUTOMATIC FREQUENCY CONTROL AGAINST TEMPERATURE CHANGE IN LINAC ACCELERATING STRUCTURES. Irie, K. (Mitsubishi Electric Corp., Tokyo). Jap. J. Appl. Phys.; 11: No. 7, 1057(Jul 1972).

22169 BEAM CURRENT POSITION, INTENSITY, AND PROFILE MONITORING BY RESISTIVE DETECTION OF BEAM IMAGE WALL CURRENTS. Faltens, A.; Hartwig, E. C.; Avery, R. T. (to United States Atomic Energy Commission). U. S. Patent 3,733,546. 15 May 1973. Filed date 21 Jul 1971. 6p.

A monitor for detecting the position, intensity and profile of a pulsed charged-particle beam moving through a beam pipe, including a pair of electrically conductive flanges inserted in the pipe, separated by an insulating ring and interconnected either with numerous resistors that are uniformly distributed around and connected in parallel between the periphery of the flanges or with a solid band of uniform resistive material or a thin resistive film is described. The pulsed beam induces image wall currents in the beam pipe which have nearly the same waveform and magnitude as the beam current but are distributed around the pipe wall according to the position of the beam. The voltages developed across the resistors are measured across the flanges at four symmetrical points. The position of the beam is a function of the differences of the voltages at opposing points, while the intensity of the beam is a function of the sum of the voltages at the four points. The profile of a beam of asymmetric cross section is indicated by the levels of the individual voltages at the four points and, for greater accuracy, at additional points. (10 claims, 7 drawing figures) (Official Gazette)

22170 MANUFACTURE OF SUPERCONDUCTING CABLES. Bronca, G.; Hlasnik, I.; Pouillange, J. P. (to Commissariat a l'Energie Atomique). French Patent 2,127,168. 26 Feb 1971. 6p. (In French).

A method is presented which enables the energy losses from high-current superconducting cables functioning in variable magnetic fields to be decreased as well as an increase in the mechanical resistance of superconducting cables functioning in dc or variable magnetic fields. High currents will be used to limit the voltages at the boundaries of superconducting cables in the magnets of future synchrotrons supplied by pulsed currents. The cable is in the form of an assembly of elementary conductors, themselves formed from twisted strands. Each elementary conductor and its conducting core are covered with a high resistivity metal or alloy having a high mechanical resistance. The assembly is impregnated with a low melting point metallic alloy without the use of an insulator. (FR)

22171 CYCLOTRON BEAM PULSING IN THE MICROSECOND RANGE AT LARGE DUTY CYCLES. Vilcov, N.; Pascovici, G.; Mytiko, A.; Vilcov, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 6, 779-780(1973).

A method of obtaining a microsecond pulsed beam at large duty cycles (< 0.25) is described. Fission fragment time spectra measured in fast neutron induced reactions are given in order to illustrate the proposed method. (auth)

22172 PARTICLE DISTRIBUTION IN A STEEL BEAM STOP FOR 28 GeV PROTONS. Bennett, G. W. (Brookhaven National Lab., Upton, NY); Brown, H. N.; Foelsche, H. W. J.; Fox, J. D.; Lazarus, D. M.; Levine, G. S.; Toohig, T. E.; Thomas, R. H.; Kostoulas, J. Particle Accel.; 4: No. 4, 229-238(1973).

The distribution of energetic particles in a steel beam stop has been measured using ^{11}C activation of polyethylene. The axial data extend to a depth of 3.1 kg/cm^2. The axial attenuation length beyond the build-up is 156 ± 1.1 g/cm^2. Results are compared with previous beam stop experiments. (auth)

22173 BEAM TRANSFORMER SYSTEM FOR MEASURING FAST EJECTION EFFICIENCIES. Cuperus, J. H. (CERN, Geneva). Particle Accel.; 4: No. 4, 189-193(1973).

Several beam transformers, connected to a common electronic system, monitor the fast ejection efficiency in the Serpikhov proton synchrotron. Just before ejection, the intensity of each of the 30 circulating bunches is measured; during ejection the same is done for each ejected bunch and after ejection the intensity of the remaining circulating bunches is measured again. All signals are digitalized and go to a minicomputer. (auth)

22174 PROBLEM OF PROTECTING HUMAN BEINGS FROM IONIZING RADIATIONS ASSOCIATED WITH ELECTRON LINEAR ACCELERATORS USED FOR HIGH ENERGY RADIOTHERAPY. Huber, H. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 98, 32-50(Nov 1972). (In French).

From 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The shielding devices used in conjunction with linear accelerators for radiotherapy are enumerated (protection of patients, hospital personnel, and the public). In addition to the useful radiation source, the possible parasitic sources are considered. The developments made are illustrated using the two linear accelerators Sagittaire and Neptune as examples. (FR)

Ion Sources and Injection and Extraction Systems

22175 (BNL-18024) PROPOSED REFINEMENTS TO RF BEAM CAPTURE PROCESS AT INJECTION IN THE AGS. Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 2 Jul 1973. 13p. Dep. NTIS $3.00.

The shortcomings of the present "Off Frequency" beam capture process are outlined and a system suggested to correct these. Frequency and rf amplitude jumps are generated electronically to avoid transfer to pick-up electrode signals until later in the accelerating process when these signals are clear or well-formed. (auth)

22176 (CEA-N-1600, pp 4-7) ANALYSIS OF HEAVY IONS FROM AN ION SOURCE UNDER TEST. Production of Fe^- and Cl^- Ions. Distribution of Charges on Cl and S. Delaunay, B. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971-September 30, 1972.

An electrostatic selector was used to analyze heavy negative ions. Some tests were performed on the production of Fe^- and Cl^- ions from $FeCl_2$. The charge distribution on Cl and S was also studied. (FR)

22177 (CEA-N-1600, pp 140-142) MODIFICATIONS TO A MULTICHARGED HEAVY-ION SOURCE. Knittner, G.; Maillard, R.; Papineau, A.; Richard, A. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971-September 30, 1972.

The magnetic field of a multicharged heavy ion source with a carbon anode (hot anode) was modified, and a magnetic channel was constructed for the beam exit. The results obtained are presented. (auth)

22178 (DNPL/R-29) RF MODULATED ELECTRON GUN FOR NINA INJECTION EQUIPMENT. Charlesworth, T. R.; Gunnill, O.; Peters, D. G.; Poole, D. E.; Saxon, G. (Daresbury Nuclear Physics Lab. (England)). 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

An 80 keV electron gun for the 40 MeV linear injector of NINA is described. The electron beam is rf modulated at 408 MHz before injection in the linac. The system carries practically all the current in two equal bunches which are best injected at about ±25° from the stable phase angle. The oxide cathodes give increasingly longer lives as the system clears up and better vacuum conditions are achieved. (UK)

22179 (LBL-1666, pp 371) CYCLOTRON INJECTION SYSTEMS. Clark, D. J. May 1973.

In nuclear chemistry annual report, 1972.

22180 PARTICLE CAPTURE WITHOUT LOSSES IN THE RF REGIME OF ACCELERATION IN A PROTON SYNCHROTRON. Myae, E. A.; Pashkov, P. T. At. Energ. (USSR); 34: No. 6, 465-470(Jun 1973). (In Russian).

The main features of quasi-adiabatic rf-capture of particles and transition to a constant-radius acceleration regime when the magnetic field changes with time and the amplitude of accelerating voltage rises in a period of time comparable with the period of synchrotron oscillations are considered. The rf-frequency is modulated so that a synchronous particle experiences no energy gain during capture and the bucket area remains constant in the transition region. As a result, the beam is turned toward the inner radius of the accelerator, but this deflection may be within the tolerance range. The tolerances for deviations of the basic parameters from the calculated values are presented. The results obtained by means of a digital computer are presented in graphical form. (auth)

22181 MEDIAN PLANE INJECTION IN THE DELFT ISOCHRONOUS CYCLOTRON. van Kampen, W. A. (Delft Univ. of Tech., Netherlands). Delft Progr. Rep., Ser. A-F; 1: 2-4(Mar 1973).

External injection of particles into an isochronous cyclotron using the precession mode of particle motion along a hill-valley boundary, is being tried in the Delft 12 MeV isochronous cyclotron. A progress report is given, describing the experimental set-up and the numerical approach to solve this kind of injection problem. (auth)

22182 GATED ION SOURCE FOR TIME-OF-FLIGHT SPECTROSCOPY. Day, R. H.; Parkinson, W. C. (Univ. of Michigan, Ann Arbor). Nucl. Instrum. Methods; 111: No. 1, 199-204(1973).

A gated ion source using tetrode geometry and having 100% gating efficiency for all ion species is described. Static transfer characteristics and gating characteristics are presented, and the effect of other charge states on the space charge limited current of a given ion species is discussed. (auth)

22183 EXPERIMENTAL INVESTIGATIONS OF Li^+ ION GUN CHARACTERISTICS. Vukanic, J.; Terzic, I. (Boris Kidrich Inst., Belgrade). Nucl. Instrum. Methods; 111: No. 1, 117-124 (1973).

An ion gun for producing beams of Li^+ ions has been constructed and its basic characteristics have been investigated. The operation of the ion source is based on the effect of the thermionic emission of Li^+ ions from beta-eucryptite ($Li_2O \cdot Al_2O_3 \cdot 2SiO_2$) which spontaneously emits an intense flux of Li^+ ions when heated above T > 1000°C. The following results of the experimental investigations were obtained: 1) Maximum ion current of the gun is about 10 μA, at beam energies of 500-2000 eV. 2) Beyond the exit of the gun a convergent axially-symmetrical beam is obtained. The minimum beam diameter is about 1 mm and occurs just at the exit of the gun. 3) Mass-spectrometer studies showed that the main impurities in the beam are ions of Na and K and they decrease with time and temperature. 4) The energy spread of the beam is very small: ≈ 0.15 eV. 5) The lifetime of the charge of the emissive material is about 50 h, and this is also the lifetime of the tungsten filament. The constructed ion gun can be used for production of ion beams of all alkali ions, depending on the aluminosilicate used as emissive material. (auth)

22184 MINIMIZING THE EFFECTS OF DISTURBING MAGNETIC FIELDS IN A CYCLOTRON AXIAL INJECTION SYSTEM. Hazewindus, N.; Otten, A. M. M.; Petterson, A. (Philips Research Labs., Eindhoven, Netherlands). Nucl. Instrum. Methods; 111: No. 1, 181-188(1973).

Magnetic stray fields generated by the cyclotron magnet may disturb the particle trajectories in a cyclotron axial injection system. Such fields have been measured at the injector cyclotron under construction for S. I. N., Switzerland. Since the fields appeared to be too strong to be tolerated, efforts were made to minimize them. Inside the axial hole this was done by using a long solenoid compensating the field, while underneath the cyclotron a layered iron shield was constructed. An additional coil was placed directly below the exit of the axial hole. The effect of these measures appeared to be very satisfactory. (auth)

22185 CYCLOTRON BEAM EXTRACTION. Hendry, G. O.; Wells, D. K. (to Cyclotron Corp.). U. S. Patent 3,725,709. 3 Apr 1973. Filed date 25 Feb 1971. 4p.

A method and apparatus are described for extraction of high beam currents from an isochronous cyclotron which segregates that portion of the orbiting particles to be extracted at the extraction radius in the absence of any electric deflection field and then electrostatically deflects the segregated particles from orbit with an electrostatic field the location of which increases in radius with respect to the center of the cyclotron. Segregation is made by a long sloped and cooled preseptum preceding an electrostatic deflection channel. (Official Gazette)

Ion Optics and Field Calculations

22186 (ANL-Trans-939) INVESTIGATION OF THE PARTICLE DYNAMICS OF A HELIX LINEAR ACCELERATOR FOR HEAVY IONS. Klabunde, J. 1970. Translated by Gerda L. Siegel (Argonne National Lab., IL) from German thesis. 173p. Dep. NTIS $10.75.

The particle dynamics of the helix linear accelerator is investigated. Differences from other accelerators made it necessary to examine in detail the applicability of the formalism used for linear accelerators, and if necessary to change it, or to develop new methods. Based on the fields which act on the particles in a helix linear accelerator, the general equations of motion are given and solved by linear approximation for longitudinal as well as for radial particle motion. The coupling between both motions is also determined by approximation in analytical form. The nonlinearity of the longitudinal motion is described using potential considerations. To confirm the results obtained by the formulas, the exact equations of motion are solved by the numerical Range-Kutta-method. Properties not obtained by approximation methods can be determined in this way. Numerous computer programs were developed. (WHK)

22187 (BNL-18113) SPACE CHARGE IN THE AGS AND SOME OF ITS CONSEQUENCES. Claus, J. (Brookhaven National Lab., Upton, N. Y.). 6 Aug 1973. 11p. Dep. NTIS $3.00.

Preliminary results of calculations with respect to the self field of the beam in the AGS and its effect on the transverse motion of

individual particles are presented. The effect appears to be severe at present intensities and means to minimize its consequences are discussed briefly. (auth)

22188 (INS-J-131) MAGNETIC FIELD MEASUREMENTS OF THE 20 cm MODEL MAGNET FOR THE 176 cm SF CYCLOTRON. Tanabe, T.; Ogawa, H.; Sakurada, Y.; Furuys, M.; Yamazaki, T. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 13 Dec 1971. 58p. INIS.

For the purpose of designing a new sector focused (SF) cyclotron, a 20 cm model magnet was constructed, and the magnetic field was measured precisely. A Siemens SBV-525 Hall generator was used for the measurement of median plane field. The measurement was performed with the following arrangements of the magnet; (1) same spiral shim and different ratios of valley to hill gaps, (2) same gap and same spiral angle, and two different types of hill width, and (3) same gap and same hill width, and two different types of the spiral angle. Data processing was carried out with computers. The observed field distribution, results of Fourier analysis of the fields, excitation curves, flutters and the spiral angles are shown. The focusing property was investigated in connection with the hill width, center angle, and the valley to hill ratio. The measurement and analysis of the fields of the 20 cm model magnet were useful for designing a 107 cm model magnet. (INIS)

22189 (LFEN-NI.-78-a) TRANSPORT OF A BEAM OF CHARGED PARTICLES USING QUADRUPOLE ELECTROMAGNETS. II. Figueiredo Dias, M. G.; Caraca, J. M. G. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1973. 30p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $3.50.

A nomogram which permits the determination of the focusing properties of a pair of quadrupole electromagnets in the hypothesis of being able to apply the approximation of designated lens is described. It is shown how the focusing distances, the amplifications, and the distances at which the images are formed can be obtained with the nomogram. (tr-auth)

22190 (RL-73-47) SECTOR MAGNET SHIM SUMS. Armstrong, A. G. A. M. (Rutherford High Energy Lab., Chilton (England)). Jun 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The TRIM code was used to find shim sizes for the sector magnet for the new 70-MeV injector for NIMROD. Results of calculations are given. (auth)

22191 (RL-73-50) SHIMMING A SECTOR MAGNET: RESULTS FROM GFUN. Armstrong, A. G. A. M. (Rutherford High Energy Lab., Chilton (England)). Jun 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The GFUN code was used to explore a range of shim sizes for the sector magnet for the new 70-MeV injector for NIMROD. Results of calculations are given. (auth)

22192 COLLIMATION OF THE INTERNAL ELECTRON BEAM IN A SYNCHROTRON. Suzuki, S. (Tokyo Univ.); Tsuru, T.; Katayama, T.; Kobayashi, M.; Iwata, S. Nucl. Instrum. Methods; 111: No. 1, 39-47(1973).

In order to reduce the effective angular spread of the electron beam which hits the internal target of the synchrotron, the effects of beam scrapers were examined. The effective angular spread is due to the primary divergence of the synchrotron beam and to multiple scattering in the target, and was estimated by comparing the angular distribution of bremsstrahlung emitted from the radiator with the theory. If the multitraversal of the electron beam through the radiator is reduced to unity, the effective angular spread obtained is equal to the primary divergence. With the use of beam scrapers appropriately distributed in the straight sections of the synchrotron, the primary divergence of 1 GeV electrons was reduced to 0.2 reduced angles (0.1 mrad). (auth)

22193 SPECIAL CLASS OF PULSED BEAM PREPARATION SYSTEMS. Hinterberger, F. (Univ., Bonn). Nucl. Instrum. Methods; 111: No. 1, 189-197(1973).

A special class of pulsed beam preparation systems is discussed with respect to the realization of high time as well as high momentum resolution. These systems are especially suited to rf-accelerators such as the isochronous cyclotrons and linacs used in low and medium energy nuclear and heavy ion physics. The ion optical components have static magnetic fields; no rf-active bunching elements are incorporated. The structure of the proposed beam preparation systems can be classified as telescopical and mirror-symmetrical. As a consequence of this structure most of the second-order aberrations are equal to zero. The first- and second-order properties are discussed. Examples of the realization of such beam preparation systems are given. (auth)

22194 MEASUREMENTS AND CALCULATIONS OF FIELD DISTRIBUTIONS IN SHORT HELICAL RESONATORS. Tombrello, T. A. (California Inst. of Tech., Pasadena); Jancaitis, K. S.; Bendt, P. J.; Erkkila, B. H.; Stokes, R. H. Particle Accel.; 4: No. 4, 195-209(1973).

Because of the current interest in short helix resonators for use in heavy ion accelerators, we have made an experimental and theoretical study of several resonator geometries. A new calculational technique has been developed to describe more accurately the boundary conditions imposed by simple shorting planes, which in resonators of $\lambda/2$ electrical length cause major perturbations of the electric field distribution and the resonant frequency. The technique is also capable of simulating other termination conditions, and allows the effect of variable pitch to be included. Comparisons have been made with measured electric and magnetic field distributions and resonant frequencies for a variety of half-wavelength designs. These comparisons demonstrate that the new method of calculation is a significant improvement over the standard sheath model. (auth)

22195 EQUILIBRIUM ORBIT AND LINEAR OSCILLATIONS OF CHARGED PARTICLES IN AXISYMMETRIC E × B FIELDS AND APPLICATION TO THE ELECTRON RING ACCELERATOR. Reiser, M. (Univ. of Maryland, College Park). Particle Accel.; 4: No. 4, 239-247(1973).

The first-order theory of charged particle motion in general axisymmetric E × B fields is presented. The fields may be produced externally or by the particles themselves; the only restrictions are that they are independent of time and azimuth angle θ, have a plane of symmetry (median plane) and that E_θ and B_θ are zero. Results are applied to the electron ring accelerator. The self fields of an electron ring with stationary ions are calculated for large aspect ratio; problems arising from the polarization of the ring are discussed and possible solutions suggested. Expressions for the betatron frequencies ν_r and ν_z for the electron motion in the ring are derived and compared with the results of Ivanov et al. and Laslett. (auth)

22196 DESIGN CRITERIA OF LINACS FOR SPECTRUM AND INSTABILITIES OF ELECTRON ENERGY. Irie, K. (Mitsubishi Electric Corp., Amagasaki, Japan). Jap. J. Appl. Phys.; 11: No. 1, 69-75(Jan 1972).

Design criteria for spectrum and instabilities of electron energy are given with the accelerating structure of the phase velocity equal to the light velocity. The broadening of energy spectrum is due to energy difference of electrons during a pulse and phase shift of electrons along the accelerating structure. For usual S-band linacs of 2 meters long operated in $2\pi/3$ mode, tolerances necessary to limit the broadening of energy spectrum within 5% are: klystron beam-voltage irregularities below 1.2%, rf frequency irregularities below 2.1×10^{-3}, temperature deviation and gradient of the accelerating structure below 1.3 degrees and 2.0 degrees, respectively, dimensional errors of the accelerating structure below 0.014 mm, and the beam loading irregularities below 5%. These values are discussed theoretically and some of them are compared with the experimental values. (auth)

Storage Rings

Refer also to abstract 22548.

22197 (COO-2271-16) FEASIBILITY OF COLLIDING BEAM EXPERIMENTS WITH LONGITUDINALLY POLARIZED ELECTRONS. Christ, N.; Farley, F. J. M.; Hereward, H. G. (Columbia Univ., New York; Royal Military College of Science, Shrivenham (England); European Organization for Nuclear Research, Geneva (Switzerland)). 1972. 19p. Dep. NTIS $3.00.

Various methods for obtaining longitudinal polarization of electrons circulating in a high-energy storage ring are analyzed. One apparently practical method is found. Such longitudinal polarization could be used to detect directly the parity violating effects of the weak interactions in proposed high energy electron-proton colliding beam machines. (auth)

22198 (KFK-1823) ANALYTICAL EXPRESSION DESCRIBING THE MAGNETIC SHIELDING PROPERTIES OF IRON PIPES FOR LONGITUDINAL MAGNETIC FIELDS. Hanke, P.; Isenbeck, W.; Moritz, J.; Schmidt, K. H.; Wegener, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

The magnetic shielding properties of iron for longitudinal fields by varying the wall thickness, length, and the diameter of the cylinder as well as the external field have been systematically investigated. An analytical expression has been derived, based on phenomenological arguments, which fits the whole data set. The study was done to develop a shield for the various radiation detec-

tors employed in the interaction region of the ISR Storage Ring. (GE)

22199 (RL-73-57) DEUTERONS IN EPIC? Lawson, J. D. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 4p. Dep. NTIS (U. S. Sales Only) $3.00.

Assuming that it proves possible to build a storage ring machine with the parameters at present ascribed to EPIC, it is pertinent to enquire whether deuterons can also be accelerated, and if so, what the luminosity for e–d collisions might be. Several points which need consideration are discussed under the relevant headings: energy range, extra equipment to handle deuterons, linac performance for deuterons, injection into booster, acceleration in booster acceleration in main ring, and electron energy limitations. It is concluded that acceleration of deuterons in EPIC is certainly a non-trivial undertaking. What can be achieved probably depends on how much money and effort are expended; for example a specifically designed 100 MeV deuteron injector linac would help a great deal. (UK)

22200 USE OF STORAGE RINGS IN HIGH ENERGY PHYSICS. Gibson, W. M. (Univ. of Bristol, Eng.). Rep. Progr. Phys.; 36: No. 8, 921-959(1973).

Some of the general considerations governing the usefulness and the practicability of storage rings, in which circulating beams of elementary particles are maintained for long periods in relation to the time for a single revolution in orbit are presented. Single storage rings for experiments on free particles, for example measurements of magnetic moment, are discussed in one section, which is followed by a chapter on colliding beam storage rings, as used especially for electron-positron collisions. In this context, the storage ring is presented as a device allowing investigation of processes which are inaccessible with the conventional arrangement of beam and stationary target. The later part of the report is concerned with intersecting storage rings for proton-proton collisions, with particular emphasis on their use for obtaining high energies in the center-of-mass system, energies which, by virtue of the relativistic relations for addition of velocities, require disproportionately high beam energies if they are to be obtained with a stationary target. The major part of this section is devoted to the CERN intersecting storage rings and the experimental work based on them, with a discussion of results obtained in the first twenty months of operation. (auth)

22201 TANTALUS I: A DEDICATED STORAGE RING SYNCHROTRON RADIATION SOURCE. Rowe, E. M. (Univ. of Wisconsin, Stoughton); Mills, F. E. Particle Accel.; 4: No. 4, 211-227(1973).

A small electron storage ring has been operated at the Physical Sciences Laboratory of the University of Wisconsin as a synchrotron radiation source for the investigation of the optical and electronic properties of solids, liquids and gases in the vacuum ultraviolet and soft X-ray region of the electromagnetic spectrum. The storage ring has proven to be a nearly ideal source for these investigations. The storage ring has also been shown to have fundamental advantages over electron synchrotrons more commonly used for this work. These advantages are stability of the electron beam as a source of photons in position, size and intensity, low levels of high energy particle radiation in the vicinity of the machine and operating vacua consistent with the requirements of the experimental program. A description of the constructional details of the storage ring, a report of its operating characteristics and a discussion of the research program that it serves is given. A summary of projects now being carried out to increase the utility of the storage ring is included. (auth)

Experimental Facilities

Refer also to abstracts 21006, 21343, 21344, and 22775.

22202 (CEA-N-1600, pp 55-56) INSTALLATION OF A 30 DEG LEFT BEAM LINE. Delaunay, B.; de Graeve, F.; Pichevar, M. 1972. (In French).

In Nuclear Physics Department annual progress report October 15, 1971–September 30, 1972.

The Van de Graaff 30 deg left beam line was installed. A new small target chamber was constructed. The electrostatic guide can be utilized as a selector. The trajectories of the beam were calculated using two methods. (FR)

22203 (CEA-N-1600, pp 56-62) ELECTRONICS. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Several modular devices have been added to the bi-analog electronic units (preamplifiers, logical control units). (auth)

22204 (CEA-N-1600, pp 63-72) COMPUTERS. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The different systems operating in the laboratory are reviewed. The three Varian systems complete the two existing wired data acquisition installations by ensuring the arithmetical processing and the real–time control operations of experiments with a large number of parameters. These systems are intended to de-allocate the CII 10020 computer for the processing and analysis of results on a time-shared basis during the experiments. A wired increment function permits direct access to the external memory; the system is multiplexed with the coupler of the visual display unit. An automatic channel function enables elementary information to be transferred directly into the external memory. Various analysis programs are described. (FR)

22205 (CEA-N-1600, pp 130-138) ELECTRONICS. Bannwarth, M.; Borrel, J.; Bricaud, B.; Chaminade, R.; Cros, M.; Desbordes, J. C.; Durruty, J.; Furtlehner, J. P.; Ingert, A.; Legrele, C.; Lugol, J. C.; Meniel, A.; Pain, J.; Rouger, M.; Sillon, Y.; Sinquin, Y. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The instrumentation system used in observations of the ^{3}He,dp) reaction is explained; the progress made in electronics, computerization, and peripheral systems is discussed together with the relevant software. A general scheme is presented for the detection electronics of the 1-GeV Saclay spectrometer, details on the more complicated aspects being presented. (FR)

22206 (CEA-N-1600, pp 147-149) POSITRON BEAMS. Aune, B.; Juillard, M.; Pacchioni, A. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The development of a new system for the production of a high intensity e^+ beam is almost completed. A new RF standing wave accelerating section for the capture of positrons is currently being developed. (auth)

22207 (CEA-N-1600, pp 152-155) BEAM SWITCHING. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Moderately fast and fast switching systems providing beams in two different experiment rooms are described. (FR)

22208 (CEA-N-1600, pp 155-159) BEAM TRANSPORT. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

In the preliminary stage of operation, the new beam transport channel leading towards the high energy room possesses an energy resolution of 10^{-4}. Measurements of the secondary electrons enable the energy of the spectra to be precisely determined. Work has already begun on the installing of the transport system into the low energy room. Complementary control installations, and visual display systems have been developed together with means for adjusting the beam. (FR)

22209 (CEA-N-1600, pp 178-181) MULTIWIRE CHAMBERS. Cohen, L.; Dupont, J.; Grunberg, C.; Le Devehat, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The apparatus associated with the multiwire chambers used in conjunction with the 600-MeV linear accelerator are described. (FR)

22210 (CONF-730618-5) UNISOR PROJECT. Spejewski, E. J.; Mlekodaj, R. L.; Carter, H. K. (Oak Ridge National Lab., Tenn.). 1973. 6p. Dep. NTIS $3.00.

From 8th international electromagnetic isotope separator conference; Skovde, Sweden (12 Jun 1973).

UNISOR is a consortium of 14 institutions which was formed for the primary purpose of studying nuclei lying far from the line of beta stability by means of an isotope separator placed on-line with the Oak Ridge Isochronous Cyclotron at the ORNL. The layout of the UNISOR building, operation of the isotope separator and tape transport system, and development of target/ion source combinations are discussed. (LCL)

22211 (DNPL/R-26) INTERNATIONAL SYMPOSIUM FOR SYNCHROTRON RADIATION USERS, DARESBURY, 4–7 JANUARY 1973. Proceedings. Marr, G. V.; Munro, I. H. (Daresbury Nuclear Physics Lab. (England)). 1973. 355p. (CONF-730126-).

From international symposium for synchrotron radiation users; Daresbury, UK (4 Jan 1973).

Separate abstracts were prepared for 15 of the 35 papers presented. The remaining 20 papers were not within the scope of NSA. (WHK)

For abstracts of individual papers see: 21970, 22212–22221, 22406, and 22428–22430.

22212 (DNPL/R-26, pp 3-12) BASIC PROPERTIES OF SYNCHROTRON RADIATION. Haensel, R. (Univ., Hamburg). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

The properties of synchrotron radiation are summarized. A table is presented showing basic parameters for all synchrotrons and storage rings where synchrotron radiation experiments are now performed or are in active preparation. A list is given of the different types of experiments performed to date with synchrotron radiation, especially beam diagnostics, spectroscopic investigations of gases and solids in the extreme ultraviolet, radiation effects, structural analysis, molecular biology, intensity calibration, and x-ray microscopy. Finally the facilities of DESY are briefly described. (UK)

22213 (DNPL/R-26, pp 13-15) SYNCHROTRON RADIATION DATA HANDLING AT DESY. Nielsen, U. (DESY, Hamburg). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

A brief account is presented of the data handling system using PDP 8/E computers connected on line to the IBM 360/65 or /75 computers at DESY. (UK)

22214 (DNPL/R-26, pp 16-21) CAMAC SYSTEM FOR COMPUTER CONTROL OF SPECTROMETERS AT THE DARESBURY SYNCHROTRON RADIATION FACILITY. Howells, M. R. (Univ. of Manchester, Eng.); Munro, I. H.; Naylor, L. 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

The Daresbury Synchrotron Radiation Facility has three monochromators in use at present. Each of these requires a monochromator drive and data collection system with independent on-line operation. The requirements of the system are outlined. The equipment chosen to meet the requirements comprises a mini computer controlling a CAMAC multicrate system, with a bi-directional data link to the site main computer. One CAMAC crate is allocated to common facilities and system functions. Each experiment has its own CAMAC crate through which all control and data transmission is performed. The equipment is described. (UK)

22215 (DNPL/R-26, pp 22-29) RECENT ACTIVITIES AT THE DARESBURY SYNCHROTRON RADIATION FACILITY. Munro, I. H. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

The important parameters associated with the synchrotron source are listed, and a plan of the facility indicates the layout of the beam lines within the laboratory and the distribution of the experiments. A computer control system has been installed for control of spectrometers and for data collection, and a number of monochromators have been constructed, installed and commissioned. At present there are four instruments operational: two normal incidence monochromators, a grazing incidence monochromator and a grazing spectrograph. These instruments are described. Experiments include: absolute measurements on metal vapors and organic materials, atomic absorption spectroscopy and photoelectron spectrometry of gases, testing soft x-ray equipment, testing replica and original gratings, solid state spectroscopy using thin film, and intensity calibration of spectral lamps. (UK)

22216 (DNPL/R-26, pp 30-36) SYNCHROTRON RADIATION FACILITIES AND ACTIVITIES AT THE PHYSIKALISCHES INSTITUT DER UNIVERSITAET BONN. Thimm, K. (Univ., Bonn). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

The synchrotron radiation facilities associated with the 0.5 GeV and 2.5 GeV synchrotrons are described. Experiments in progress or planned include (a) absorption studies with gases and vapors, (b) a solid-state investigation of the temperature-dependence of the lines of plasmon-resonances at low temperatures, and (c) calibration of spectrometers for investigations of solar ultraviolet radiation in the range from about 100 to 1000 Å. Some details of the instruments are given. (UK)

22217 (DNPL/R-26, pp 37-45) SYNCHROTRON RADIATION EMITTED BY THE ORSAY STORAGE RINGS AND PROPOSED EXPERIMENTS. Dhez, P.; Durup, J.; Farge, Y.; Guyon, P. M.; Jaegle, P.; Leach, S.; Lopez-Delgado, R.; Marin, P.; Vermeil, C. (Paris Univ., Orsay, France). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

A description is given of the electron-positron storage ring, ACO, maximum energy 550 MeV, and the utilization of its synchrotron radiation, with some details of the light pipe and monochromators. Experiments planned for 1973 include: measurements of radiative lifetimes of some organic compounds, absorption spectra of some heavy metal gases, resonant absorption of certain transition and rare earth elements, photoemission spectroscopy of some II-VI and III-V compounds, and absorption and photoemission spectroscopy of molecules. Preliminary details are given of a new ring, DCI, energy 1.7 GeV, at present under construction; and of the proposals for utilizing its synchrotron radiation. (UK)

22218 (DNPL/R-26, pp 68-87) GRAZING INCIDENCE SPECTROMETERS, CRYSTAL SPECTROMETERS AND SCATTERED LIGHT PROBLEMS. Kunz, C. (DESY, Hamburg). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

It is stated that electron accelerators and storage rings are unique light sources in the vacuum ultraviolet and x-ray regions but for most applications it is only possible to estimate their usefulness when combined with a specific monochromator. Monochromators for the x-ray region are discussed in combination with the synchrotron, under the following heads: synchrotron parameters (acceptance window, size of the source, and distance from the source); grazing incidence monochromators (optical elements and scattered light problems and monochromator mountings); and crystal monochromators (general remarks, double crystal monochromator, XPS monochromator, and monochromator for diffraction work). It is concluded that monochromators for the x-ray region will be built rather as integrated parts of any experiment than as separate universal devices. (UK)

22219 (DNPL/R-26, pp 94-100) INITIAL EXPERIMENTS WITH A GRAZING INCIDENCE MONOCHROMATOR. West, J. B.; Codling, K.; Marr, G. V. (Univ. of Reading, Eng.). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

A description is given of a constant deviation grazing incidence spectrometer designed for the Daresbury synchrotron. It is a zero deviation, vertically dispersing instrument, consisting basically of a plane grating followed by a concave mirror which focuses the diffracted light onto a horizontal exit slit. The angles of incidence are so arranged that second order radiation should be suppressed over a limited wavelength region. The performance of the spectrometer is discussed. (UK)

22220 (DNPL/R-26, pp 101-105) ONE-METER GRAZING INCIDENCE SPECTRO-MONOCHROMATOR USING TWO GRATINGS FOR SYNCHROTRON LIGHT. Jaegle, P.; Dhez, P.; Wuilleumier, F. (Paris Univ., Orsay, France). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

A description is given of a spectro-monochromator, designed to work in the 20 to 1000 Å wavelength range, which is being built for synchrotron radiation users of the Orsay storage ring ACO. To avoid spectral order overlapping a two-grating system was chosen which can be used with any kind of concave grating (ruled or holographic). A further constraint was that the experimental setup had to be used either as a monochromator or as a spectrograph. A large spectral range must be focused along the Rowland circle. A sketch of the two-grating system, involving an intermediary mirror with a radius of curvature equal to the radius of the gratings, is shown. (UK)

22221 (DNPL/R-26, pp 251-253) ESRIN-BONN-IMPERIAL COLLEGE COLLABORATIVE EXPERIMENT ON ATOMIC AND MOLECULAR ABSORPTION SPECTROSCOPY BETWEEN 10 AND 100 A. Connerade, J. P. (Imperial Coll. of Sci. and Tech., London). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

A brief account is given of the present status of experiments in progress at the Physikalisches Institut, University of Bonn, on the study of absorption phenomena in atomic and molecular gases and vapors. The studies will involve both the 2.5 GeV and the 0.5 GeV electron synchrotrons. Preliminary results on cadmium and mercury are mentioned in connection with the 2.5 GeV synchrotron, and measurements in nitrogen and argon in connection with the 0.5 GeV machine. Particular reference is made to equipment and instruments. (UK)

22222 (FRNC-TH-383) RESEARCH AND DEVELOPMENT FOR A SPECTROMETER CHANNEL OF THE GRENOBLE ISO-

CHRONOUS CYCLOTRON ENABLING A MOMENTUM RESOLUTION OF 10^{-4} TO BE ACHIEVED. Leroux, J. P. (Grenoble Univ. (France)). 1973. 198p. (In French). Dep. NTIS (U. S. Sales Only) $12.00.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

An analysis channel was developed for the Grenoble isochronous cyclotron. A spectrometer channel was also studied. Calculations effected in the first and second order using the ORBITE and TRANSPORT programs are explained. The components of the spectrometer channel (two sextupoles, a quadrupole, and a dipole) are currently being subjected to measurements. Theoretical calculations indicate that a resolution function of less than 0.2 mm can be obtained over a 0.16% energy band in the focal plane which corresponds to an overall resolution of 1.1×10^{-4}. (FR)

22223 (HMI-B-135) BEAM HANDLING SYSTEM FOR VICKSI. Hinterberger, F. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Apr 1973. 198p. (In German). Dep. NTIS (U. S. Sales Only). $12.00.

The design of the (Van de Graaff–isochronous cyclotron combination) (VICKSI) beam handling system described provides nine target places. Under them six target places are reached after the passage of two 90°-bending magnets for which the following beam preparation modes are possible: (1) double dispersive in order to get dispersion matching when magnetic spectrometers are used (energy resolution up to 1:8000). (2) non-dispersive with variable compensation of the time of flight dispersion effect in order to get a very sharp time of flight resolution (in the order of 100 psec) combined with a variable energy resolution (up to 1:4000). (3) achromatic for every double monochromator combination. The ion optical properties of the system are studied, and some technical relevant aspects are mentioned. (auth)

22224 (KFK-1816) CONSIDERATIONS ABOUT THE DESIGN OF A MAGNETIC SPECTROMETER FOR THE KARLSRUHE ISOCHRONOUS CYCLOTRON. Gils, H. J.; Schatz, G. (Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium). Jun 1973. 53p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

The general concept of a high-resolution magnetic spectrometer for the Karlsruhe Isochronous Cyclotron is discussed with regard to the experiments to be performed with this apparatus, taking into account the properties of the external beam. The most suitable instrument seems to be an energy-loss spectrometer with vertical beam dispersion, horizontal scattering plane and vertical momentum analysis. A special design is proposed, the properties of which are described on the basis of beam transport calculations up to second order. (GE)

22225 (LBL-1666, pp 359-360) SEARCH FOR NEW ISOTOPES WITH THE He-JET TECHNIQUE AT THE BEVATRON. Bowman, J. D.; Poskanzer, A. M.; Eppley, R. E.; Hyde, E. K. May 1973.

In nuclear chemistry annual report, 1972.

22226 (LBL-1666, pp 361-364) DESIGN OF, AND SKIMMER TESTS WITH, A He-JET TRANSPORT SYSTEM. Gough, R. A.; Sextro, R. G.; Cerny, J. May 1973.

In nuclear chemistry annual report, 1972.

22227 (LBL-1666, pp 379-380) HILAC DATA COLLECTION PROGRAM. Hunter, J. B.; Jared, R. C.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

22228 MEDIUM-ENERGY PROTON SYNCHROTRON AS A SOURCE OF INTENSE KAON BEAMS. Basargin, Yu. G.; Komar, E. G.; Lobashev, V. M.; Shukeilo, I. A. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). Dokl: Akad. Nauk SSSR; 209: No. 4, 819-821(1973). (In Russian).

The convenience of generating kaon beams of moderate energies with a 5 to 7 GeV proton accelerator is elucidated. A fast synchrotron with an injector with an average intensity of 100 μA of the type referred to as a "meson factory" is recommended, operating with accelerator pulses of negative ions in the injector so as to coincide with the frequency of the changing field in the synchrotron. (KSW)

22229 $L_0 \geq L$ TIME-OF-FLIGHT NEUTRON SPECTROMETER AND MEASUREMENT OF HIGH MOMENTUM TRANSFER STRUCTURE FACTOR IN MOLECULAR LIQUIDS. Misawa, M.; Kai, K.; Suzuki, K.; Takeuchi, S. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 73-81(Dec 1972).

In order to measure the static structure factor, S(Q), of liquid metals up to high Q momentum transfer, a new time-of-flight neutron spectrometer has been installed on the Tohoku University 300-MeV electron linear accelerator. By choosing the flight path length from the source to sample, L_0, much greater than the path length from the sample to detector, L, one can accomplish almost ideal integration loci in the (Q,ω) plane to obtain S(Q). As a preliminary measurement the structure factors of CCl_4 and CS_2 molecular liquids were observed up to $Q \cong 30$ Å^{-1} by the spectrometer. (JA)

22230 NEUTRON PARAMAGNETIC SCATTERING FROM Mn OXIDES USING ELECTRON LINEAR ACCELERATOR. Watanabe, N. (Tohoku Univ., Sendai); Ishikawa, Y.; Tsuzuki, K. Kakuriken Kenkyu Hokoku; 5: No. 2, 106-114(Dec 1972). (In Japanese).

A new type of spectrometer to measure neutron incoherent inelastic scattering has been installed at the pulsed neutron source at the Tohoku electron linear accelerator. The monochromatized pulse neutron beam is obtained by Bragg reflection from the large pyrolytic graphite plate with mosaic spread of 3.5° which is placed about 2.7 meters from the pulsed neutron source. A counter bank composed of 6 BF_3 counters which is placed about 2 meters apart from the sample with the glancing solid angle of 0.025 ster. detects the scattered neutrons. The installation has been used to detect the neutron paramagnetic scattering from the various manganese oxides. The investigation has been aimed to determine the direct interaction between the Mn^{2+} ions in oxides which has been reported to play an important role in the magnetic interaction. It was found that five hours operation is sufficient to accumulate the data for energy spectra of the scattered neutrons with reasonable energy resolution and fairly good signal-to-background ratio if the incident neutrons with the wavelength of about 4 Å are used. Preliminary results obtained for MnO, $MnTiO_3$, and $MnGeO_3$ are presented. (auth)

22231 IMPROVEMENTS TO LINEAR PARTICLE ACCELERATORS. Henry-Bezy, G.; Leboutet, H. (to Thomson-CSF). French Patent 2,135,424. 4 May 1971. 15p. (In French).

A very small linear particle (principally electrons) accelerator is presented. The accelerator is intended for gamma radiography or radiotherapy in which high-energy particles bombard a high atomic number target, this target subsequently emitting x-or γ-rays. The smallness of this accelerator facilitates its orientation; the radiation emitted from the target can thus be used where it is required (part to be irradiated). The indispensable elements are positioned along the accelerating cross section and housed in a small cylinder. (FR)

22232 OSCAR: A MULTIPROGRAMMED SMALL COMPUTER SYSTEM FOR EXPERIMENTAL NUCLEAR PHYSICS. Blatt, S. L.; Sinclair, J. W. D.; Raymond, L. A. (Ohio State Univ., Columbus). Nucl. Instrum. Methods; 111: No. 1, 53-59(1973).

The central component of the data acquisition and analysis system at the Ohio State University Van de Graaff Laboratory is an IBM 1800 computer, operating under a powerful multiprogramming monitor. The system has been designed to allow efficient usage of the computer resources by several experimentalists at once. Under typical conditions, the processor is shared concurrently by data acquisition and display routines, an "on-line" data reduction or experimental control program, and an "off-line" analysis or system updating job. Operations are enhanced by two interactive display units. The system has been found to be flexible, easy to program, and straightforward to interface. (auth)

22233 REAL-TIME 448 000-CHANNEL MULTIPARAMETER PULSE HEIGHT ANALYSIS SYSTEM. Sinclair, J. W.; Smith, J. W.; Rozsa, C. M.; Blatt, S. L. (Ohio State Univ., Columbus). Nucl. Instrum. Methods; 111: No. 1, 61-65(1973).

A multiparameter pulse-height analysis system, operating on a small multiprogrammed computer with auxiliary magnetic disk memory, has been developed at the Ohio State Van de Graaff Laboratory. The method enables experimentalists to collect data in arrays up to 448 000 channels, at coincidence rates of over 300 per second. The data may be viewed as it is collected, and is ready, in histogram form, as soon as data-collection is completed. (auth)

22234 LOW-ENERGY NEUTRON TIME-OF-FLIGHT EXPERIMENTS. Inoue, K.; Otomo, N.; Iwasa, H.; Kiyanagi, Y. (Hokkaido Univ., Sapporo). Hokkaido Daigaku Kogakubu Kenkyu Hokoku; No. 66, 75-85(Mar 1973). (In Japanese).

Low-energy neutron time-of-flight experiments using the pulsed neutron source of the Hokkaido University 45-MeV electron LINAC were carried out. This paper describes the 5-meter neutron time-of-flight facility. Cold-neutron spectra from the very cold ice at 18°K and the condensed ethane at 22°K were measured as an application of this facility. (auth)

22235 ION OPTICAL PROPERTIES OF THE MUNICH Q3D-SPECTROGRAPH INVESTIGATED BY MEANS OF A SPECIAL 'XPERIMENTAL RAY TRACING METHOD. Loeffler, M.; cheerer, H. J.; Vonach, H. (Univ., Munich). Nucl. Instrum. Methods; 111: No. 1, 1-12(1973).

The ion optical properties of the Munich Q3D-spectrograph were investigated using a special experimental ray tracing

method. Cs^+-ions produced in a thermal ion source were accelerated by means of a very stable dc-voltage and focused on the object point of the spectrograph (spot size 0.2×2 mm^2). From this ion beam a set of rays corresponding to those used in ray tracing calculations was obtained by a special collimator system. The positions of these rays were measured in the region of the focal plane with an accuracy of about 0.15 mm. From these measurements we have been able to determine the ion optical properties of the spectrograph including aberration coefficients up to 4th order. The results are compared to ray tracing calculations for the spectrograph. Within the accuracy of both the ray tracing calculations (due to uncertainties in field boundaries), and the measurements reasonable agreement is found. (auth)

22236 GAS TARGET CELL FOR ABSOLUTE CROSS SECTION MEASUREMENTS. Mesko, L.; Valek, A. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 1, 61-63(1973). (In Hungarian).

A target cell filled with N_2 was used to determine exactly the number of target atoms and the absolute value of the differential cross-section of the $^{14}N(d,p)^{15}N$ and $^{14}N(d,\alpha)^{12}C$ nuclear reactions. The experiment required determination of the relative angular distribution of the reaction products of the volatile adenine ($C_5N_5H_5$) target at various bombarding energies. Foils of Al_2O_3 prepared by anodic oxidation were used to separate the cell from the high-vacuum region prevailing in the accelerator. The cell, made by drilling a 4-mm-dia hole in a stainless steel block, was tested at a pressure of 30 mm Hg and used at 20 mm. The gas was introduced from a cylinder through a needle valve. The bombardment caused deposition of carbon on the foils, increasing the average thickness to 25 μg/cm^2. The experimental error in the determination of the number of target atoms was estimated at 3.5%; most of the error was attributed to the length measurement of the target cell. (TTT)

22237 CHARGED PARTICLE BEAM DEFLECTION CONTROL YOKE. Hashmi, Z.; McNitt, D. H. (to Ford Motor Co.). U. S. Patent 3,748,612. 24 Jul 1973. Filed date 15 Nov 1971. 6p.

A control yoke for deflecting a beam of electrically charged particles is described. The yoke includes a pair of parallel and spaced bars on each of which a plurality of electrical coils are positioned. The bars are made from a magnetic material. Current in the coils produces a magnetic field between the bars which varies in flux density, thereby, varying the amount of deflection of the beam. (Official Gazette)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 21363, 22401, 22507, 22589, and 22731.

22238 COMPOSITION OF THE COSMIC RADIATION ABOVE 10 GeV PER NUCLEON: IMPLICATIONS FOR ORIGIN AND PROPAGATION. Cartwright, B. G. (Univ. of Chicago). Astrophys. Lett.; 14: No. 3, 157-160(1973).

Recent measurements of the chemical composition of the cosmic rays at energies above 10 GeV/N imply an energy dependence of the mean amount of matter traversed after acceleration by the cosmic radiation. However, the observed proton, alpha-particle, and electron differential energy spectra can be used to exclude simple models which attempt to account for this phenomenon on the basis of energy-dependent confinement times or containment volumes. (auth)

22239 METEORITES AND COSMIC RADIATION. Cameron, I. R. Sci. Amer.; 229: No. 1, 65-73(Jul 1973).

Topics covered in this review include space erosion, effects of high- and low-energy bombardment, variations of cosmic-ray intensity, cooling rates of parent bodies, exposure ages, lunar materials, particle-track densities, superheavy nuclei, fission tracks, spallation, and spallation products. (WDM)

22240 ELECTRON FLUXES WITH ENERGIES > 80 MeV AT THE EQUATOR BASED ON MEASUREMENT DATA FROM THE KOSMOS-490 SATELLITE. Basilova, R. N.; Grigorov, N. L.; Kalinkin, L. F.; Pugacheva, G. I.; Pryakhin, E. A.; Savenko, I. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 147-148 (1973).

Intensive electron fluxes with energies $E_e > 10^8$ eV, which are comparable to primary cosmic-ray fluxes, have been detected in experiments on the Proton-1 and -2 satellites. In order to check these results and make them more accurate an instrument for recording electrons with $E_e > 10^8$ eV based on an operating principle different from the one used earlier was installed on Kosmos-490. The operating principle was based on the ability of electrons to produce electron-photon cascade showers in high-Z matter. (WDM)

22241 UPPER LIMIT OF ANTINUCLEI CONTENT IN PRIMARY COSMIC RAYS. Ivanova, N. S.; Kulikov, V. N.; Yakubovskii, E. A. (Ioffe Inst. of Physics and Tech., Leningrad). Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 151-152(1973). Translated from Kosm. Issled.; 11: No. 1, 163-165(1973).

The ratio of antinuclei to ordinary nuclei in the primary cosmic radiation is determined to be less than 0.05%. (WDM)

22242 ORIGIN OF COSMIC RADIATION. Audouze, J.; Meneguzzi, M. (CNRS, Paris). Recherche (Paris); 4: No. 35, 550-555(Jun 1973). (In French).

The recent bout of discoveries such as pulsars and the refining of experimental methods currently available to research workers bring new light on astrophysics problems. (FR)

22243 ROLE OF NEUTRON STARS IN THE ACCELERATION OF COSMIC RAYS. Cameron, A. G. W. (Yeshiva Univ., New York). pp 279-294 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Neutron stars may be effective in two ways in accelerating cosmic radiation. The first possibility is that material is accelerated from the surface of the star and the second that it is accelerated in an electromagnetic wave interaction with the supernova ejecta. Various models of neutron-star atmospheres are considered to see if the surface composition might yield abundances of elements as found in cosmic radiation. The main contributions to cosmic rays are found to be helium and the iron peak elements, helium being ejected at a possible rate of 10^{21} grams per event. The effects of the electromagnetic fields around a neutron star would probably be to accelerate some of the heavier debris from the supernova explosion into the cosmic ray flux of the Galaxy, but at lower energies than the material from the surface. (DE)

22244 SUPERNOVA EXPLOSIONS. Cameron, A. G. W. (Yeshiva Univ., New York). pp 248-278 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The mechanisms leading to production of supernovae explosions are considered. An evolutionary game or model is proposed which can account for the relative abundances of nucleosynthesis products, the chronology of radioactive elements, the gas content of the Galaxy, and the light element content of cosmic radiation. (DE)

22245 INTERPLANETARY DECELERATION AND THE SIGNIFICANCE OF THE OBSERVED COSMIC RAY. Deuteron and ^{3}He Fluxes. Meyer, J. P. (CEN de Saclay, Gif-sur-Yvette, France). pp 235-247 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The implications of low-energy deuteron and ^{3}He observations concerning source spectra are discussed, in view of the adiabatic deceleration in the solar cavity. The three main mechanisms for d and ^{3}He formation are spallation of cosmic ray ^{4}He on interstellar protons, spallation of interstellar ^{4}He by cosmic-ray protons and the $pp \rightarrow d\pi^+$ reaction. The d/^{4}He ratios for these reactions are calculated for the extreme spectra $E_0 = 0$ and $E_0 = 938$ MeV/N. The effects of solar adiabatic deceleration on these spectra are considered. Comparison of observations with these results implies a source spectrum close to power law in total energy, $\phi(E)\,(E_0 + E)^{-2.6}$, for $E_0 > 500$ MeV/n. (DE)

22246 EFFECTS OF PROPAGATION AND SOURCE DISTRIBUTION ON COSMIC RAY COMPOSITION AND ANISOTROPY. Ramaty, R. (Goddard Space Flight Center, Greenbelt, MD); Lingenfelter, R. E. pp 203-234 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The propagation and source distribution of cosmic rays is considered. The principal requirement for the various models considered is that they should be capable of holding particles in dense regions of the galactic disk for periods of time sufficient to produce the observed fragmentation products of cosmic rays. This can be achieved by both simple and compound diffusion provided that suitable mean free paths and boundary conditions are chosen. The bulk of the anisotropy is caused by the discrete nature of the cosmic-ray sources. However, models which reproduce the fragmentation products will in general yield anisotropies consistent with available upper limits. (auth)

22247 SOME RELATIONS BETWEEN ELECTRONS, POSITRONS, AND THE ISOTOPIC COMPOSITION IN INTERSTELLAR SPACE. Burger, J. J. (Kammerlingh Onnes Lab., Leiden). pp 173-202 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

A model for the propagation of cosmic rays through interstellar space is proposed, under the assumption that primary electrons and nuclei have a common origin. Observations of these components should be capable of being fitted to a common source and propagation model. The losses which occur during propagation and their consequent effects on the spectra are considered. These include ionization, leakage, spallation, and decay for nuclei and ionization, leakage and E^2-losses for electrons. The parameters confinement volume and storage time are calculated. Intensity variations can also give useful information on solar modulation mechanisms. The nonthermal radiation data is used to provide information about cosmic-ray characteristics in the confinement region. (DE)

22248 POSSIBLE EFFECTS OF INTENSE LOW ENERGY COSMIC RAY FLUXES. Meneguzzi, M.; Audouze, J.; Reeves, H. (CNRS, Paris). pp 169-172 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

It has previously been shown that the GCR fluxes (with source spectra shaped as a power law in total energy) could account both for the observed GCR isotopic ratios at energies larger than some hundred MeV/N and for the abundances of ^{6}Li, ^{9}Be, and boron in the solar system and some F and G stars. These GCR fluxes are unable to explain the heating of H I regions and the ^{7}Li overabundance in many F stars and in the solar system. The ^{7}Li in some star surfaces is possibly an heritage of thermonuclear processes such as suggested by Cameron and Fowler (1971). An alternative model is presented in order to explain both the Li overabundance ($Li/H = 10^{-9}$) and the heating of H I regions. The GCR flux cannot rise very steeply from the GeV region all the way until the MeV

range but the real shape of the GCR below 100 MeV/N is not known. Therefore there is the possibility, while keeping a total energy power law source spectrum at energies higher than some tens of MeV, to add an intense low-energy component. This component may increase the Li abundance and the heating without changing too much the Be abundance since the reactions producing Be have thresholds larger than those producing Li. (auth)

22249 NITROGEN IN COSMIC RAY SOURCES. Meneguzzi, M.; Audouze, J.; Reeves, H. (CNRS, Paris). pp 161-168 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Typical results are shown of certain well-known processes such as hydrogen burning through CNO cycle; helium burning and simple "ejection" from normal stars. These numbers should serve mostly as qualitative indications since they depend somewhat on the specific conditions in which the process has taken place (for instance: attainment or nonattainment of an equilibrium regime). First the (C/CNO) at the sources (~0.45) is significantly larger than the average stellar value (~0.26) and certainly much larger than the CNO cycle value. On the other hand the products from helium burning (pure ^{12}C and ^{16}O) appear to be in the correct ratio (although some uncertainty remains with the nuclear parameter (Barnes, 1970). According to Lezniak et al. (1969) the flux of cosmic-ray N particles may be entirely of secondary origin. This result would of course strongly support a relationship between the GCR sources and the helium burning process. Shapiro and Silberberg (1970) however do not agree with the suggestion of Lezniak et al (1969). The present authors have investigated whether the uncertainties on both the GCR observations and the nuclear parameters would support a meaningful answer. (DE)

22250 BERYLLIUM ISOTOPIC COMPOSITION IN COSMIC RAYS. Meneguzzi, M.; Audouze, J.; Reeves, H. (CNRS, Paris). pp 157-160 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The beryllium isotopic composition in galactic cosmic rays (GCR) is interesting in two respects: ^7Be decays by electron capture—it is then expected to be stable at high energy and to decay at low energy. The radioactive isotope ^{10}Be (half life = 2.7×10^6 years) is known to be an indicator of the mean interstellar hydrogen density traversed by GCR, and therefore of the GCR age. If the density is low, most of the ^{10}Be produced by spallation has decayed, but for a density of the order of 1 atom cm^{-3} only a small fraction decays. The calculation presented by Reeves is used to investigate the Be isotopic composition. Results are shown for $n_H = 1$ and $n_H \ll 1$ (n_H = number of H atoms per cm^3 in the interstellar medium). ^7Be is found to be the dominant isotope in both cases. The $^7Be/Be$ value is still a matter of controversy. The first experimental values gave $^7Be/Be = 0.30$, but Webber quotes a value of 0.75 in the range 100 to 200-MeV/N. The calculation is in agreement with this last value. The calculated Be/(Li + B) ratio is shown as a function of energy, together with Shapiro's calculation, for $n_H = 1$ and $n_H = 0.1$. The difference between the two calculations gives an indication of the effects of the various uncertainties (mainly the cross sections); the discrepancies between experimental points and the uncertainties in the calculations show that no conclusion can be drawn. The ratio $^{10}Be/^9Be$ in the same conditions is also given. This ratio seems to be the most sensitive test of the mean hydrogen density traversed by GCR. Its measurement would be of great interest. (auth)

22251 PRODUCTION OF THE ELEMENTS Li, Be, B BY GALACTIC COSMIC RAYS IN SPACE. Meneguzzi, M.; Audouze, J.; Reeves, H. (CNRS, Paris). pp 147-156 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Stellar and solar occurrences of the L elements, Li, Be, and B, can be explained by their production in nuclear spallation reactions in galactic cosmic rays. The parameters of this model needed to account for the observed features of the galactic cosmic rays and the abundances of the elements are derived. Observations of ^6Li, ^9Be, and ^{10}B are in good agreement with the model. The two remaining L elements, ^7Li and ^{11}B, occur in too great quantities to be produced by the cosmic-ray flux. They are, however, the only two produced in stellar thermonuclear reactions in reasonable amounts. (DE)

22252 ^7Be AND OTHER ELECTRON CAPTURE ISOTOPES IN COSMIC RAYS. Raisbeck, G. (CNRS, Orsay, France). pp 139-146 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Initial comparisons between the distribution of Be isotopes as measured in cosmic rays with that predicted from nuclear fragmentation cross sections suggested that there might be substantially less ^7Be than predicted. Further experimental cross-section measurements have been carried out in our laboratories with a view to examining a wider range of production processes. (Protons on carbon, alphas on carbon, protons on ^{11}B.) A related problem, the possible destruction of ^7Be by atomic electron capture in the interstellar medium, followed by nuclear decay is considered. Such a process is of interest for a number of other pure electron capture isotopes in cosmic rays. A series of experiments on the electron capture process in some of these elements has been carried out. Proton beams are incident on target foils of mylar, Al, Ni, and Ta at energies of 40, 155, and 600 MeV. The OBK predictions for nonradiative capture give reasonable agreement up to about 100 MeV. (DE)

22253 SOME RESULTS ON CROSS SECTION MEASUREMENTS IN THE LOW ENERGY RANGE. Epherre, M. (CNRS, Orsay, France). pp 135-137 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The importance of the L elements (Li, Be, and B) is well established now in the study of many astrophysical and cosmic-ray problems. It is very useful to know as well as possible the excitation function of these elements in their main targets: ^{12}C, ^{16}O, and ^{14}N. These measurements were undertaken at Orsay some years ago. Cross sections measured for reactions induced by protons of energy lower than 50 MeV on ^{14}N and ^{16}O are given. ^7Be and ^{11}C were measured in ^{14}N by radiochemical techniques. The target was pure VN. The irradiations were performed between 6 and 40 MeV, the charge was collected on the target mounted in a Faraday cup and measured by an integrator circuit. ^{11}C, which is a β^+ emitter and has a half life of 20 min, was measured just after the irradiations by two NaI(Tl) scintillators in coincidence. ^7Be was measured by means of its 477 keV γ ray with a high resolution Ge Li γ spectrometer, because of the contributions of 511 keV protons due to positron annihilation from the radioelements formed in vanadium. (auth)

22254 EXPERIMENTAL DETERMINATION OF PROTON AND ALPHA PARTICLE INDUCED SPALLATION. Cross-Sections in Oxygen, Carbon, and Boron. Yiou, F. (CNRS, Orsay, France). pp 118-134 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Recent data on cosmic-ray isotope ratios, particularly $^7Be/\Sigma Be$, has shown a discrepancy between the experimental value and that predicted from cross-section data on proton-induced spallation of carbon and oxygen. The origins of this discrepancy are discussed, with particular reference to the role of alpha particle induced spallation in the production of Li, Be, and B. Cross sections for alpha-induced reactions have been measured at Orsay by mass spectrometry, low-level counting, and radiochemical methods. The results show that a 10 to 20% contribution to the cross section from alpha-induced reactions is possible. The tertiary origin of ^{10}Be in the $^{11}B(p,2p)^{10}Be$ reaction is also shown. (DE)

22255 HEAO SATELLITE PROPOSAL ON CHEMICAL AND ISOTOPIC COMPOSITION OF PRIMARY COSMIC RAYS. Koch, L. (CEN de Saclay, Gif-sur-Yvette, France). pp 99-116 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

A common satellite proposal issued from the Danish Space Research Institute and the Centre d'Etudes Nucleaires de Saclay was accepted late 1970 by NASA Scientific Committee as a possible candidate for the High Energy Astronomical Observatory program. The purpose of the experiment is to determine in the galactic cosmic radiation, in the rigidity interval 4 to 15 GV; a) the flux and the energy spectrum of each element between beryllium and tin, b) the isotopic composition of the abundant elements from beryllium to iron in the same rigidity interval which corresponds to 1.5 to 7 GeV/N. The above mentioned rigidity interval is determined by the 28.5° inclination of the orbit of the satellite and not by the experimental procedure. In the instrument to be used in the satellite the charge and velocity of each nucleus is measured by the double Cherenkov technique, associated with a spark chamber visualization of the trajectories of the nuclei. The mean mass of an element in the cosmic radiation can be obtained in terms of the mean mass of an arbitrary reference element from two mea-

surements of their relative fluxes. One measurement is of fluxes at equal rigidity, using the geomagnetic field to provide the rigidity filter. The other measurement is of fluxes at equal momentum nucleon, using the velocity resolution of the instrument itself to provide the filter. (auth)

22256 ISOTOPE ANALYSIS WITH THE HELP OF A CRYOGENIC MAGNET. Dauber, P. M. (Univ. of California, Berkeley). pp 89-98 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Individual cosmic-ray nuclei can be identified isotopically using a magnetic spectrometer in conjunction with counters. The spectrometer measures rigidity, which is equal to momentum divided by charge (R = P/Z), and the counters determine velocity, β, and charge Z. The mass is calculated from the relation $DM = RZ/\beta\gamma = RZ\,(1/\beta^2 - 1)^{\frac{1}{2}}$. The instrumental alternatives are scintillators, which measure Z^2/β^2; Cherenkov counters, which measure $Z^2(1 - 1/\beta^2n^2)$ and a time of flight system which measures β directly. Thus, one scintillator and one Cherenkov counter, or two Cherenkov counters with different indices of refraction n, or a Cherenkov counter plus time of flight will suffice. In order to illustrate the capability of this method a specific experimental configuration is considered namely that now being built by the Berkeley cosmic-ray group. (auth)

22257 ISOTOPE ANALYSIS WITH NUCLEAR EMULSIONS. Kristiansson, K. (Univ. of Lund, Sweden). pp 79-88 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The mass resolution which can be expected in measurements of cosmic-ray heavy particles in nuclear emulsion is discussed. The estimates of the errors are based on accurate measurements with nuclear track photometers of the relations between track width and residual range in tracks of beryllium, carbon, oxygen, neon, magnesium, and iron. It is found that satisfactory isotope resolution can be reached for nuclei in the charge region $3 \leq Z \leq 8$. The error in a mass determination is in this region smaller than $\frac{1}{2}$ atomic mass unit. The error in the region $10 \leq Z \leq 16$ amounts to about $\frac{1}{2}$ atomic mass unit and some uncertainty will arise in estimates of isotopic abundances in this element interval. The accuracy is at present insufficient for isotope analyses in the iron region. (auth)

22258 STUDY OF ISOTOPES OF HEAVY COSMIC RAY NUCLEI BY MEANS OF TRACKS IN PLASTICS. Price, P. B. (Univ. of California, Berkeley). pp 63-78 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

A method of studying isotopic composition of cosmic rays by examination of etch pit lengths in plastic is described. It has been found that this length is dependent on ionization rate. A plot of residual range vs. cone length over the whole energy range gives a straight line plot with different slopes for each isotope, enabling analysis of the composition. Experiments in an accelerator beam, using cellulose nitrate, showed that it is possible to separate ^{10}B from ^{11}B in this way. For cosmic-ray experiments, lexan was used, being a more reproducible, though less sensitive, substance. Favorable separation of the heavier nuclei, from ^{20}Ne up to ^{238}U was achieved. For these nuclei a power law dependence of etching velocity, Vr, on ionization, J, $Vr = J^{1.8}$ is seen, though no explanation of this has yet been found. (DE)

22259 RECENT RESULTS ON CHEMICAL AND ISOTOPIC COMPOSITION IN THE HIGH ENERGY REGION. Tandon, S. N. (Danish Space Research Inst., Lyngby, Denmark). pp 53-62 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

The results from a series of balloon flights made by the Danish Space Research Institute are reported. The purpose of the flights was to study the fine details of the charge composition, and gross features of isotopic abundance in near relativistic cosmic rays. The essential elements of the instrument are three narrow gap wire spark-chambers for defining the trajectories of the particles, two heavy glass Cherenkov counters and a low refractive index liquid Cherenkov counter. The principle of the method is outlined. The basic requirements needed to derive reliable information on isotopic abundance from the pulse height distributions in the low refractive index counter are discussed. These concern charge separation, statistical fluctuations in pulse height, and elimination of interactions. Results on the chemical composition in the charge range $Z \geq 20$ and isotopic abundance are presented. (DE)

22260 ISOTOPE EXPERIMENTS USING THE GEOMAGNETIC FIELD. Lund, A. (Danish Space Research Inst., Lyngby, Denmark). pp 39-52 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

A new attempt has been made to improve the technique of extracting isotopic information with the help of the magnetic field of the Earth. The basic ideas behind the new approach are explained. The treatment is divided in two sections. In section 1 the influence of the geomagnetic field on the particle fluxes is discussed and it is shown that an exact knowledge of the local cutoffs is not needed for the experiments. In section 2 the finite velocity resolution of the counter to be used is taken into account and the limitations which this imposes on the results and on the experimental procedures are discussed. (DE)

22261 RECENT MEASUREMENTS OF CHARGE AND ISOTOPE COMPOSITION USING CHARGE COUNTERS. Webber, W. R. (Univ. of New Hampshire, Durham). pp 12-38 of Isotopic Composition of the Primary Cosmic Radiation. Lyngby, Denmark; Danish Space Research Institute (1971).

From symposium on isotopic composition of primary cosmic radiation; Lyngby, Denmark (23 Mar 1971).

Measurements made at the University of New Hampshire of the charge and isotope composition of cosmic-ray nuclei are discussed in detail. Some of the limitations of these measurements and their potential for future development are also discussed. Some of the recent experimental results are discussed, concentrating on the charge and isotopic composition of the so-called light nuclei, Li, Be, and B, and also on the charge composition in the $15 \leq Z \leq 30$ range. Some preliminary interpretations of this data are presented. (auth)

22262 CARBON/OXYGEN RATIO IN HIGH-ENERGY COSMIC RAYS. Juliusson, E.; Meyer, P. (Univ. of Chicago). Astrophys. Lett.; 14: No. 3, 153-155(1973).

The abundance distribution of cosmic-ray nuclei at 0.6 GeV/N, 1.6 GeV/N, and between 20 and 100 GeV/N was measured by balloon-borne instrumentation. It was found that the abundance ratio of carbon to oxygen decreases from 1.1 around 1 GeV/N to a value of about 0.8 at energies above about 30 GeV/N. Some implications of this result are discussed. (auth)

22263 FLUCTUATIONS OF ATMOSPHERIC RADIOCARBON. Grey, D. C. Tucson, AZ; Univ. of Arizona (1972). 238p. University Microfilms Order No. 73-13,326.

Thesis (Ph. D.).

^{14}C variations occur on both long and short time-scales. There are several causes of the observed variations. These causes fall into two general classes: (I) Variations in the rate at which ^{14}C is produced in the atmosphere, and (II) variations in the physical and chemical processes by which ^{14}C is transported and exchanged within and between the several reservoirs of the Earth system. Extant estimates of ^{14}C production exceed the total decay in the Earth's reservoirs. The present work included a search for additional ^{14}C in overlooked or underestimated reservoirs, with negative results. A theoretical model of the way in which the solar-flare (sunspot) activity affects the amount of ^{14}C in the atmosphere was developed, and shows that much of the short-term (i.e., decade to century periods) variation is due to modulation of ^{14}C production by the solar wind. The model also provides rather precise data on the mean life of a CO_2 molecule in the atmosphere (4 to 7 years) and the mean time for dissipation of a disturbance in atmospheric ^{14}C concentration (about 100 years) and on the Suess effect (maximum of about 2% in 1968). Long-term ^{14}C variations are shown to be explained by a model which describes the effects of the varying geomagnetic field. The model shows that ^{14}C production and decay are not in equilibrium, but the amount of disequilibrium is not adequate to explain the difference between production and decay estimates. It is concluded that production and decay estimates. It is concluded that production is overestimated. A 2% residuum in the long-term variation around 6000 years ago is still unexplained, and is hypothesized to be due to an earlier period of high production, such as from a magnetic reversal or supernova injection. Seasonal variations in tropospheric ^{14}C concentration after the 1962 nuclear-weapon tests are shown to be almost entirely due to the fluctuating tropopause height, and this mechanism is shown to account for about a third of the annual stratosphere–troposphere exchange. The study of this mechanism provides values of air transport between stratosphere and troposphere, and between hemispheres. Uptake of ^{14}C by the oceans is calculated and is shown to be relatively large at low latitudes, despite the apparent supersaturation of

the oceans with respect to CO_2. A biological control is hypothesized. (Diss. Abstr. Int., B)

22264 MANGANESE-54 AND THE LIFETIME OF RELATIVISTIC COSMIC RAYS. Cassé, M. (Service d'Electronique Physique, Centre d'Etudes Nucléaires de Saclay, B.P. n°2, Gif-sur-Yvette, 91, France). Astrophys. J. 180: No. 2, 623-629 (1 Mar 1973).

When present in high-energy cosmic rays, the unstable isotope ^{54}Mn cannot decay by electron capture since it is fully ionized. However, it is β-radioactive. Its half-life, in its own frame of reference, is estimated to be 2.10^6 years (within a factor of 2) from the well-established theory of "unique second forbidden" transitions. It seems relevant to assume that ^{54}Mn is mostly created by nuclear collisions of cosmic-ray Fe on interstellar hydrogen. Since its production cross-section from ^{56}Fe is as high as 30 mb, i.e., comparable with those of ^{55}Mn and ^{53}Mn (both around 40 mb), ^{54}Mn is expected to be an interesting cosmic-ray clock. (auth)

22265 FLUX AND ENERGY SPECTRUM OF FAST NEUTRONS AND GAMMA RAYS AT BALLOON ALTITUDES. Klumpar, D. M. Durham, NH; Univ. of New Hampshire (1973). 142p. University Microfilms Order No. 73-16,743.

Thesis (Ph. D.).

An organic liquid scintillation detector employing pulse shape discrimination was used in a series of balloon flights to measure the flux and energy spectrum of fast neutrons ($E > 3$ MeV) and gamma rays ($1 \leq E \leq 10$ MeV) near the top of the atmosphere. The differential neutron leakage spectrum from 3 to 20 MeV at the top of the atmosphere over Palestine, Texas ($\lambda = 42°N$) normalized to solar minimum can be described by a spectrum of the form $0.276\ E^{-1.80}$ ($3 \leq E \leq 10$ MeV), $0.035\ E^{-0.9}$ ($10 \leq E \leq 15$ MeV), $0.0068\ E^{-0.3}$ ($15 \leq E \leq 20$ MeV). The spectrum above 20 MeV inferred from the data may be described by $0.003\ E^{0.0}$ ($20 \leq E \leq 50$ MeV) and $6.98\ E^{-2.0}$ ($50 \leq E \leq 100$ MeV) neutrons/cm^2 sec MeV over the indicated energy ranges. The leakage current out of the atmosphere is found to be 0.09 neutrons/cm^2 sec between 3 and 10 MeV and 0.27 neutrons/cm^2 sec between 3 and 100 MeV. For a balloon flight from Ft. Churchill, Canada ($\lambda = 68°N$) the 3 to 20-MeV neutron leakage spectrum extrapolated to the top of the atmosphere and normalized to solar minimum is given by $0.423\ E^{-1.65}$ ($3 \leq E \leq 10$ MeV), $0.075\ E^{-0.9}$ ($10 \leq E \leq 15$ MeV), $0.015\ E^{-0.3}$ ($15 \leq E \leq 20$ MeV) and the inferred spectrum above 20 MeV by $0.006\ E^{0.0}$ ($20 \leq E \leq 50$ MeV) and $15.1\ E^{-2.0}$ ($50 \leq E \leq 100$ MeV) neutrons/cm^2 sec MeV over the indicated energy ranges. Integrating one obtains a vertical leakage flux of 0.17 neutrons/cm^2 sec from 3 to 10 MeV and 0.58 neutrons/cm^2 sec between 3 and 100 MeV. Implications of this result for the Cosmic Ray Albedo Neutron Decay Theory (CRAND) are discussed. The atmospheric gamma-ray spectrum was measured between 1 and 10 MeV and is described by a double power law function of the form $0.82\ E^{-2.2}$ ($1 \leq E \leq 4$ MeV) and $0.36\ E^{-1.6}$ ($4 \leq E \leq 10$ MeV) photons/cm^2 sec MeV with a total flux of 0.66 photons/cm^2 sec at 3.5 g/cm^2 during the balloon flight from Palestine, Texas. At 6 g/cm^2 over Ft. Churchill, Canada the gamma-ray spectrum is described by $1.05\ E^{-2.2}$ ($1 \leq E \leq 4$ MeV) and $0.4\ E^{-1.5}$ ($4 \leq E \leq 10$ MeV) photons/cm^2 sec MeV with a 1 to 10 MeV flux of 0.86 photons/cm^2 sec. (Diss. Abstr. Int., B)

22266 INTERACTION OF FAST PARTICLES WITH WAVES IN COSMIC MAGNETOACTIVE PLASMA. Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Annu. Rev. Astron. Astrophys.; 11: 363-386(1973).

Topics covered in this review include: general concepts; turbulent broadening of spectral lines; fast particles and the degree of ionization; role of fast particles in cosmic conditions; mechanisms of fast particle and magnetoactive plasma wave interactions; interaction between fast particle and plasma waves; wave instabilities caused by fast particles; isotropization of cosmic rays; and energy spectrum of relativistic particles. (WDM)

22267 ANGULAR EFFECTS IN THE PROPAGATION OF COSMIC RAYS IN THE ATMOSPHERE. Torsti, J. J.; Terho, R. W. (Univ. of Turku, Finland). Nuovo Cim.; 16B: No. 2, 376-386(11 Aug 1973).

A method is presented for the calculation of differential energy spectra for cosmic-ray particles at different zenith angles in the atmosphere. Special emphasis is laid on the angular dependence of differential cross sections for various collision models and decay processes, the deflections of particle trajectory due to the multiple scattering, and the the bending in the geomagnetic field are taken into account in the propagation. As an application, the muon intensities in the energy range (10 to 6000) GeV and at large zenith angles ($\theta > 80°$) at sea level were calculated by using two well-known models for the particle production in the collisions. The differences in the resulting muon spectra increase with increasing zenith angle and with increasing energy. The effects of the multiple scattering on the muon intensities are negligible except in the range (10 to 30) GeV, where the neglect of the multiple scattering causes a reduction of the intensities which is about 20% at the highest. The vertical intensities are calculated for the range (1 to 3000) GeV. The predicted intensities are in agreement with the recent measurements of Allkofer et al. (auth)

Stars

Refer also to abstract 22351.

22268 IRON, CARBON, AND NITROGEN ABUNDANCES OF THE SUBDWARF GROOMBRIDGE 1830. Tomkin, J.; Bell, R. A. Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 117-127(1973).

An effective temperature of 5000 K has been determined for the subdwarf Gmb 1830 using spectral scan data. The iron abundance is found to be about 20 × less than that of the Sun, this being a revision of an earlier result (Tomkin, Mon. Not. Astr. Soc.; 156: 349 (1972)). The carbon abundance is about 25 × less than the solar value. The weak features of the violet (0,0) band of CN have been used to estimate the nitrogen abundance. This has been done by comparing the actual spectrum with synthetic spectra that have been computed for various nitrogen abundances. The comparison shows that nitrogen is about 5 × more deficient than iron. (auth)

22269 ADIABATIC STABILITY OF STARS CONTAINING MAGNETIC FIELDS. 2. Poloidal Fields. Markey, P.; Tayler, R. J. (Univ. of Sussex, Eng.). Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 77-91(1973).

It is shown that, if a star contains a poloidal magnetic field with field lines closed within the star, it is almost certain to suffer from hydromagnetic instabilities with a growth time very much shorter than the thermal time scale of the star. The motions driven by these instabilities are almost entirely parallel to surfaces of constant gravitational potential. The ultimate result of the instabilities is unclear. In the first instance they are likely to become oscillations of finite amplitude. If their wavelengths are short enough they may be damped by resistivity and this could lead to a substantial reduction of magnetic flux in the star. This simple result will be affected by rotation and the presence of a toroidal component of magnetic field. Neither of these factors is considered in detail in the present paper but it is made plausible that the instabilities might be suppressed if the toroidal magnetic field is comparable in strength with the poloidal field. (auth)

22270 ULTRA-VIOLET PHOTOMETRY OF EARLY TYPE STARS FROM TD1 SATELLITE OBSERVATIONS. Humphries, C. M.; Nandy, K.; Thompson, G. I. (Royal Observatory, Edinburgh). Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 1-11(1973).

An ultraviolet photometric system is proposed which enables determination of spectral type and interstellar reddening for early type stars. The method is based on observations obtained from the Ultraviolet Sky-Survey telescope in the satellite TD1. The photometric system considered here consists of ultraviolet magnitudes at $\lambda_1 = 2750$ Å, $\lambda_2 = 2500$ Å, $\lambda_3 = 2190$ Å, and $\lambda_4 = 1490$ Å. Ultraviclet colour indices for unreddened stars have been determined in the spectral type range from 0 to A5, and are compared with the results obtained from rocket observations. It is found that a colour difference method can be applied to obtain a reddening free parameter which gives the spectral type to an accuracy within ±2 subclasses; this accuracy is limited by intrinsic scatter in the ultraviolet colour vs. spectral type relationships. (auth)

22271 ABUNDANCE AND AGE DISTRIBUTIONS OF 500 F STARS IN THE SOLAR NEIGHBOURHOOD. Clegg, R. E. S.; Bell, R. A. (Univ. of Maryland, College Park). Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 13-28(1973).

The uvby catalogue of Perry has been used, in conjunction with theoretical uvby colors and stellar evolutionary tracks, to obtain the metal abundance distribution and age distribution of F and G type dwarf stars within 100 pc of the Sun. Eighty-three per cent of the stars with spectral type F5-G2 have metal content within a factor 2.5 of the solar abundance, and only 2 per cent have less than one-quarter the solar abundance. The metal abundance distribution, which contains more metal-rich stars than found in previous investigations of F and G dwarfs, has also been compared with the observed metal abundance distribution of G and K giants and the model galaxy calculations of Truran and Cameron (Astrophys. Space Sci.; 14: 179 (1971)). A comparison of the age distribution with evolutionary calculations implies that the rate of star formation in the Galaxy may not have decreased by a large factor in the last 10 billion years. Space velocities have been computed for 200 stars and the correlation of abundances with galactic orbits studied. Little evidence has been found for a

radial composition gradient in the Galaxy, suggesting that the abundance variation found by Janes and McClure (Bull. Am. Astron. Soc.; 4: 241 (1972)) is restricted to CN. (auth)

22272 OPTICAL PROPERTY OF TYPE I OH-STARS. Fillit, R.; Foy, R.; Gheudin, M. (Observatoire, Meudon, France). Astrophys. Lett.; 14: No. 3, 135-140(1973).

To find a criterion to help in the discovery of new OH-stars of type I, the photometric properties of these stars were investigated. To compile a sample of stars as uniform as possible, Mira variables with periods longer than 200 days, of spectral type Me, and nearer than 900 pc were selected. In this sample, OH-stars are found to have a larger V-I color index by about 0.8 mag than non OH-stars with a light curve of the same amplitude. The stellar distances are shown not to be a source of bias for this excess in V-I. A photospheric origin for this excess is discussed. Six new OH-stars of type I were discovered in this way: four among the sample, and two farther than 900 pc, observed because of their large values of V-I. (auth)

22273 OPTICAL OBSERVATIONS OF THE RADIO STAR MWC 349. Kuhi, L. V. (Institut d'Astrophysique, Paris). Astrophys. Lett.; 14: No. 3, 141-145(1973).

Absolute flux measurements of the optical emission-lines in MWC 349 suggest that the radio free–free emission must be optically thick, and that the cause of the infrared excess cannot be primarily free–free emission, but originates in re-radiation from dust. The central star has $M_v = -7.9$ mag and a Zanstra temperature $\geqq 45{,}000°K$. (auth)

22274 PHOTOELECTRIC STUDY OF EE AQUARII AND AE PHOENICIS. Williamon, R. M. Gainesville, FL; Univ. of Florida (1972). 199p. University Microfilms Order No. 73-15,608.

Thesis (Ph.D.).

Photoelectrically observed light curves of the eclipsing binary star systems EE Aquarii and AE Phoenicis were obtained. The Russell model was assumed, and the light curves were constructed and rectified with the techniques of Russell and Merrill (Contr. Prin. Obs. No. 26, 1952). For EE Aquarii, a ratio of the radii of 0.69, a radius of the larger star of 0.468, a luminosity of the larger star of 0.915, and an inclination of the orbit of 68.47° were found. For AE Phoenicis, a ratio of the radii of 0.574, a radius of the larger star of 0.485, a luminosity of the larger star of 0.739, and an inclination of the orbit of 85.53 were found. The eclipsing binary EE Aquarii has an amplitude of light variations of 0.65 m for primary and 0.20 m for secondary. The period is 0.50899558 d, and the eclipses are partial with primary a transit and secondary an occultation. AE Phoenicis is a W Ursae Majoris type eclipsing binary with a period of 0.36237456 d. The primary eclipse is a complete occultation and the secondary is a transit. Complications were encountered in the case of AE Phoenicis in that a rather large term proportional to the cosine of the phase angle was present in yellow and ultraviolet light, an asymmetry proportional to the sine of the phase angle was present for all colors, and a small amount of orbital eccentricity was also possibly present. (Diss. Abstr. Int., B)

22275 MORE CROSS-SECTIONS FOR THE EXCITATION OF HIGHLY EXCITED ATOMS BY ELECTRONS. Banks, D. (Univ. of Stirling, Scotland); Percival, I. C.; Richards, D. Astrophys. Lett.; 14: No. 3, 161-162(1973).

Cross-sections for transitions between levels of highly excited atoms in H I regions are obtained in analytic form. (auth)

22276 INTERPRETING EARLY-TYPE STELLAR SPECTRA. Mihalas, D. (National Center for Atmospheric Research, Boulder, CO). 46: No. 2, 79-83(Aug 1973).

Formation of stellar spectra is briefly discussed and recent analyses of early-type spectra are reviewed. (WDM)

22277 DRIFTING SUB-PULSE PHENOMENON IN PSR 0809+74. Page, C. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 29-40(1973).

PSR 0809 + 74 has been observed simultaneously at 81.5 MHz and 151 MHz in order to study drifting sub-pulses and the effects of pulse nulling. It is found that drifting sub-pulse bands are generated with a periodicity which is stable to at least 1 part in 10^3 when allowance is taken of a characteristic jump of sub-pulse phase associated with nulls. The overall behavior is similar at both frequencies, apart from an increased sub-pulse width at 151 MHz, although the mean pulse envelope is substantially broader at 81.5 MHz. The relevance of these observations to pulsar models is briefly discussed. (auth)

22278 SYSTEMATIC ERRORS IN CEPHEID TEMPERATURES AND PULSATIONAL MASSES. Schmidt, E. G. (Royal Greenwich Observatory, Herstmonceux, Eng.). Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 67-75(1973).

It is shown that the relation between (B-V) and temperature commonly used for calculating pulsational masses of Cepheids is seriously in error for stars with periods longer than about 10 days. The use of (R-I) improves the situation and theoretical colours are calculated from model atmospheres in order to allow the determination of more accurate temperatures for the long period stars. These temperatures lower the pulsational masses of the most luminous Cepheids by about 35 per cent. It is concluded that data currently available for such stars are not sufficient to determine the masses from pulsation theory and further (R-I) observations are needed. (auth)

22279 CONVECTION IN A PERIODIC GRAVITATIONAL FIELD. Ivanov, L. N. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 7: No. 1, 82-91(1971).

Translated from Astrofizika; 7: No. 1, 143-158(1971).

The time-dependent convective energy flux expression for periodic variation of the acceleration due to gravitational force is obtained in the agitation-length-theory approximation. Compressibility of the matter is taken into account only in calculation of the buoyancy force acting upon the convective elements. It is shown that the tidal density variations possible can only increase the amplitude of the convective flux oscillations. (auth)

22280 DISTINCTIVE FEATURE OF LONG-PERIOD VARIABLE STARS OF THE MIRA CETI TYPE. Vardanyan, R. A. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 1, 92-93(1971).

Translated from Astrofizika; 7: No. 1, 159-161(1971).

One of the fundamental parameters of long-period variable stars is the time for the brightness increase. The question as to whether or not this parameter is correlated with the amplitude of the brightness variation. (WDM)

22281 MILNE PROBLEM WITH PERTURBATION ON THE BOUNDARY. Grinin, V. P. (Crimean Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 7: No. 1, 1-11 (1971).

Translated from Astrofizika; 7: No. 1, 5-22(1971).

The problem of nonstationary luminescence of a stellar atmosphere is considered. It is assumed that a temperature perturbation is due to a radiation source of variable intensity appearing on the boundary. The basic equations of the source function $S(\tau,u)$ and of the reflected intensity $I_\delta(u)$ are given. These equations were derived by taking into account the perturbation of optical properties of the atmosphere. An approximate solution of the problem in the one-dimensional case is obtained, and a physical interpretation of the results is given. (auth)

22282 NUMERICAL RESULTS FOR SOBOLEV'S FUNCTION Q OF RADIATIVE TRANSFER. Buell, J.; Kalaba, R.; Ueno, S. Astrophysics (Engl. Transl.); 7: No. 1, 12-20(1971).

Translated from Astrofizika; 7: No. 1, 23-37(1971).

The function Q is the solution of the Fredholm integral equation. Sobolev has emphasized the importance of this function in the theory of radiative transfer and multiple scattering. The method of invariant imbedding is used to obtain numerical values of the function Q. (auth)

22283 LINE FORMATION IN THE PRESENCE OF A MAGNETIC FIELD. II. Source Functions. Domke, H. (Astrophysical Observatory, Potsdam, Ger.). Astrophysics (Engl. Transl.); 7: No. 1, 21-31(1971).

Translated from Astrofizika; 7: No. 1, 39-56(1971).

Line formation in stellar atmospheres in the presence of a uniform magnetic field is discussed within the framework of the Milne–Eddington model. Scattering is assumed to occur with total redistribution of frequencies. Scalar source functions dependent solely upon optical depth are introduced. A system of Wiener–Hopf type integral equations is derived for these functions. The system degenerates into a single equation in some particular cases. The resolvent of the system of integral equations is expressed in terms of generalized H-functions, for which a system of nonlinear integral equations is derived, by extending Sobolev's method to the vectorial case. Outgoing radiation is also expressed in terms of these functions for the case of linear dependence of the energy output of the primary sources on the optical depth. (auth)

22284 BRIGHTNESS VARIATIONS OF CLOSE BINARY SYSTEMS OF DWARF STARS. Gorbatskii, V. G. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 7: No. 1, 32-36(1971).

Translated from Astrofizika; 7: No. 1, 57-64(1971).

An examination is made of the influence of gas streams in close binary systems of dwarf stars on the observed light curves. The profile of the hump preceding the primary minimum on the light curve is computed. By comparing the observed hump with the computed one, an estimate is made of the optical thickness of the radiating layer in the disk-shaped envelopes of VV Pup and U Gem. It is shown that the brightness fluctuations in these systems can

be caused by inhomogeneities in the turbulent gas jets that collide with the envelopes. (auth)

22285 FROZEN STARS AND MULTIPLE SYSTEMS. Guseinov, O. Kh.; Novruzova, Kh. I. (Shemakha Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 7: No. 1, 37-40 (1971).

Translated from Astrofizika; 7: No. 1, 65-70(1971).

From among the spectroscopic binaries, 13 systems in which the invisible components are more massive were selected. If it is assumed that the invisible star is on the main sequence and if its luminosity is estimated from its mass, the luminosity turns out to be greater than that of the visible component in the majority of cases. This and other facts suggest that some of the binaries cited have a relativistic star as the second component. (auth)

22286 MOTION OF A GAS IN CLOSE BINARY SYSTEMS. II. Korovyakovskii, Yu. P. (Special Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 7: No. 1, 41-47(1971).

Translated from Astrofizika; 7: No. 1, 71-82(1971).

Trajectories of the motion of gas flows in the close binary systems U Gem, VV Pup, and UX UMa are calculated in the three-dimensional case, taking into account the dynamic effects of the gas pressure. The coordinates of the point of intersection of the gas flow from the companion with the envelope of the principal star are obtained for various values and directions of the initial velocities. The velocity of intersection of the gas flow with the envelope is 500 to 550 km/sec for the system UX UMa, 550 to 600 km/sec for the system VV Pup, and 900 to 1000 km/sec for the system U Gem. An attempt is made to explain the different power of the luminosity of the "hot spot" in the systems U Gem, VV Pup, WZ Sge, and in the systems UX UMa, DQ Her. (auth)

22287 SOME CHARACTERISTICS OF THE FLARE ACTIVITY OF UV Cet TYPE STARS. I. Oskanyan, V. S.; Terebizh, V. Yu. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 1, 48-54(1971).

Translated from Astrofizika; 7: No. 1, 83-94(1971).

A statistical analysis of observational data on flares of stars UV Cet in 1967–1969 and YZ CMi in 1967–1970 is presented. It is shown that the flare activity of these stars did not change during the years mentioned. An examination of the number of stellar flares in fixed time intervals and time intervals between flares shows that the sequence of flares on stars UV Cet and YZ CMi is close to Poissonian. (auth)

22288 NEWTONIAN THEORY OF RAPIDLY ROTATING WHITE DWARFS. Papoyan, V. V.; Sedrakyan, D. M.; Chubaryan, E. V. (Erevan State Univ.). Astrophysics (Engl. Transl.); 7: No. 1, 55-61(1971).

Translated from Astrofizika; 7: No. 1, 95-105(1971).

The structure and integral parameters of rotating equilibrium pseudospheroidal models of white dwarfs are determined as rigid bodies rotating at angular velocity Ω in the Ω^4 approximation. The results diverge only slightly from similar results obtained in the Ω^2 approximation, so that it can be safely assumed the Ω^2 approximation is just as applicable as the Ω^4 approximation in the case of configurations in a state critical with respect to outflow of material. Comparison of the results found here and results obtained by the more exact James method are in excellent agreement. (auth)

22289 EVOLUTION AND RADIAL PULSATIONS OF ISOTHERMAL WHITE DWARFS WITH ALLOWANCE FOR ROTATION, NEUTRONIZATION, AND GENERAL RELATIVITY THEORY. Vartanyan, Yu. L.; Ovsepyan, A. V. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 7: No. 1, 62-69(1971).

Translated from Astrofizika; 7: No. 1, 107-119(1971).

The evolution of isothermal rotating white dwarfs executing radial pulsations is discussed. Neutronization effects (inverse β-decay processes) and general relativity theory corrections are both taken into account. Evolution curves, density dependence of the temperature, and also stability loss points are calculated for different assigned masses. The corresponding pulsation periods are found. (auth)

22290 HIGH RESOLUTION OBSERVATIONS OF SUPERNOVA REMNANTS AT 80 MHz. Dickel, J. R. (Univ. of Illinois, Urbana). Aust. J. Phys.; 26: No. 3, 369-377(Jun 1973).

Observations of 10 supernova remnants with a resolution of about 4′ arc at 80 MHz have enabled the spectra of several of these objects to be extended to this low frequency. From the results only the well-known supernova remnant G43.3 – 0.2 (W49B) shows conclusive evidence for curvature in its integrated spectrum at low frequencies in agreement with previous work. Some discrepancy between the conclusions and those from a related survey of small diameter supernova remnants by Dulk and Slee (1972) is noted. Contour maps are presented for five of the more extended sources with a resolution equal to or greater than any previous maps. These results have been compared with higher frequency data in a search for possible changes in spectra across individual sources. G189.1 + 2.9 (IC443) has been found to have a nearly constant spectral index over most of its extent with perhaps a somewhat flatter spectrum on its southern side. (auth)

22291 PERIODS FOR TWO VARIABLES IN M13. Osborn, W. (Yale Univ., New Haven). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 91-96(1973).

Periods of 0.381767d and 0.392665d have been derived for the M13 variables 5 and 9, which form a close optical double. New observations are presented for these stars, and it is shown that the observations given by Kollnig–Schattschneider (Astr. Nach.; 273: 145 (1942)) for variable 5 in fact refer to variable 9. Both variables appear to be of RRc type with B amplitudes of 0.6 magnitude. (auth)

22292 EFFECT OF ROTATION ON NONLINEAR THERMAL CONVECTION. Van der Borght, R.; Murphy, J. O. (Monash Univ., Clayton, Australia). Aust. J. Phys.; 26: No. 3, 341-357 (Jun 1973).

The effect of rotation on nonlinear thermal convection is investigated, in particular at high Rayleigh number. The Boussinesq approximation is adopted in the basic equations and the free boundary conditions are applied. The results derived from asymptotic and perturbation methods are found to be in very good agreement with those obtained by numerical integration. (auth)

22293 SUPERHEAVY ELEMENTS AND THE R-PROCESS. Schramm, D. N. (California Institute of Technology, Pasadena; Institute of Theoretical Astronomy, Cambridge, England); Fiset, E. O. Astrophys. J. 180: No. 2, 551-570 (1 Mar 1973).

Detailed, microscopic–macroscopic fission–barrier calculations have been carried out along the r-process path. It has been found that the results are qualitatively similar to the semiempirical results of Schramm and Fowler in that the r-process yield of nuclei with $A \gtrsim 290$ is strongly dependent on the surface symmetry correction to the surface energy of the nucleus. If this surface symmetry correction is represented by the nuclear parameter κ, then it can be said that the r-process will not produce nuclei with $A \gtrsim 290$ if $\kappa \gtrsim 2.3$, whereas finite yields of superheavy elements are possible for $\kappa \geq 2.3$. Detailed calculations following the decay of nuclei from the r-process path back to the valley of beta stability (superheavy island) have been carried out. These calculations indicate that it is possible that the predicted longest-lived nucleus $^{294}110$ might decay back might deplete the (even–N, even–Z) nucleus. The details of the decay back were found to be extremely sensitive to the assumed rates, and thus no strong conclusions on abundance yields can be reached. This sensitivity is removed if N=196 is a magic or semimagic number since there would be only negligible fission competition on the way from the r-process path to the island. The large number of assumptions and uncertainties going into superheavy elements and r-process calculations are discussed in detail. (auth)

22294 ACCRETION ONTO BLACK HOLES: THE EMERGENT RADIATION SPECTRUM. Shapiro, S. L. (Princeton University Observatory, Princeton, New Jersey). Astrophys. J. 180: No. 2, 531-546 (1 Mar 1973).

The luminosity and frequency spectrum of radiation resulting from interstellar gas accreting onto a black hole are calculated. The model is that of spherically symmetric, steady-state accretion onto a nonrotating black hole at rest in the interstellar medium. A fully relativistic treatment (including special- and general-relativity effects) of both the fluid mechanics and radiation processes has been used. The principal radiation mechanisms are electron–proton and electron–electron bremsstrahlung. The results for a black hole of mass $M=1\ M_\odot$ depend on whether the interstellar medium is an H I or an H II region. For an H I region with $n_0=1$ cm^{-3} and $T_0=100°$ K, the total luminosity $L=3\times10^{25}$ ergs s^{-1}. The spectrum has a bremsstrahlung shape with $T\sim10^9\,°$ K. An H II region with $n_0=1$ cm^{-3} and $T_0 = 10{,}000°$K produces $L=2\times10^{21}$ ergs s^{-1}. The spectrum is again bremsstrahlung in appearance with $T\sim10^{11}\,°$ K. In both cases only a small fraction of the available thermal energy is radiated. For different values of n_0, T_0, and M the spectral distribution remains the same while the total luminosity $L\varnothing M^2T_0^{-3}n_0^2$, provided $(M/M_\odot)(T_0/100°\text{K})^{-3}n_0 \ll 10^2$ for the H I region and $(M/M_\odot)(T_0 10{,}000°\text{K})^{-2}n_0 \ll 10^6$ for the H II region. The possibility of detecting this radiation and thereby identifying black holes is discussed. (auth)

22295 EXPONENTIAL GROWTH RATES OF CONVECTIVE MOTION IN AN ADVANCED RED GIANT. Fawley, W. M. (Princeton University Observatory). Astrophys. J. 180: No. 2, 483-485 (1 Mar 1973).

In this paper, e-folding times are determined for the fundamental adiabatic convective mode of 1 $M_\odot$ red-giant models. It is found that these times are nearly constant, even at the evolution phase at which the star becomes dynamically unstable with respect to radial modes

because of the effects of hydrogen and helium ionization. Furthermore, it is shown that at this phase the e-folding time for the convective modes is much shorter than that characteristic for the radial modes. (auth)

22296 A NON-LTE STUDY OF SILICON LINE FORMATION IN EARLY-TYPE MAIN-SEQUENCE ATMOSPHERES. Kamp, L. W. (Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 180: No. 2, 447-468 (1 Mar 1973).

We have computed populations of 16 levels of Si III–V and radiation fields in all connecting transitions; in particular the first six Si III triplet levels, including the λ4553 line, and the first six Si IV levels including λ4089. The computations were done for four non-LTE H-He model atmospheres, provided by Auer and Mihalas, with T_{eff}=25,000°, 30,000°, 35,000°, and 40,000° K, all with log g=4. Estimates of corresponding MK types are B1.5 V, B0.5 V, O9 V, and O6. Solutions were obtained by iterating the linearized equations of radiative transfer and statistical equilibrium, except that for less important lines an approximate "equivalent two-level atom" treatment was used. Continuous opacities of C, N, O, and Ne were included. All abundances were "solar" values. (auth)

22297 MODELS OF POPULATION I CLUMP GIANTS. Faulkner, D. J.; Cannon, R. D. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, The Australian National University). Astrophys. J. 180: No. 2, 435-446 (1 Mar 1973).

The main-sequence, giant-branch, and core-helium-burning evolution is investigated for low-mass stars with original composition (X,Y,Z) = (0.68, 0.30, 0.02). Stars of 1.5 and 2.0 $M_M^* = M_\odot$ are evolved to the helium flash with a careful treatment of the pause on the giant branch caused by the hydrogen-burning shell passing through the abundance discontinuity left behind by surface convection. This pause is too brief to explain the observed clump of giant stars in intermediate-age open clusters. (auth)

22298 HELIUM ABUNDANCES IN NGC 2264, II SCORPII, AND I LACERTAE. Peterson, D. M. (Department of Earth and Space Sciences, State University of New York, Stony Brook); Shipman, H. L. Astrophys. J. 180: No. 2, 635-645 (1 Mar 1973).

We determine the helium abundances of three clusters and associations: NGC 2264, II Sco, and I Lac. The very young cluster NGC 2264 has an abundance of N(He) =0.08 while the two associations have abundances of N(He) =0.10. The difference is significant at the 3 σ level. (auth)

22299 APPLICATION OF THE COMPLETE-LINEARIZATION METHOD TO THE PROBLEM OF NON-LTE LINE FORMATION. Auer, L. (Yale University Observatory). Astrophys. J. 180: No. 2, 469-472 (1 Mar 1973).

It is shown that the equations of statistical equilibrium may be incorporated directly into the transfer equation, thus reducing the basic matrix size for the complete-linearization method. Treatment of weak transitions and development of starting solutions are also discussed. (auth)

22300 ATMOSPHERIC STRUCTURE AND CHEMICAL COMPOSITION OF COOL HELIUM AND CARBON WHITE DWARFS. Grenfell, T. C. Seattle; Univ. of Washington (1972). 206p. University Microfilms Order No. 73-13,826.

Thesis (Ph. D.).

The atmospheric parameters were found which determine the atmospheric structure of the white dwarfs van Maanen 2 (DG), G47-18 (λ4670), and G99-37 (λ4670). L145-141 (DC) was also investigated. For van Maanen 2 (vMa 2) the spectra were calibrated using the photoelectric scans of Oke and Shipman (1970). Model atmospheres were calculated for these stars. The initial effective temperature of vMa 2 was 5500°K, and the effective temperatures of G47-18 and G99-37 were estimated from a grid of models. The model atmospheres were constructed using a modified version of the fully linearized Feautrier method (Auer and Mihalas 1969) including variable Eddington factors. The code was modified to include the possibility of energy transport by convection using the mixing length theory. With this technique, flux constancy was achieved to high accuracy and agreement with previously calculated models by Wegner (1971) was quite good. All the models showed a steep increase in the temperature at the point where convection sets in, and this point was found to be quite high in the atmosphere. The model atmospheres calculated for vMa 2, G47-18, and G99-37 were used to compute synthesized spectra, the distribution of emergent energy flux as a function of wavelength, from 3500Å to 9500Å. (TSS)

22301 EFFECTS OF DEPARTURES FROM LTE IN STELLAR SPECTRA. Mihalas, D.; Athay, R. G. (National Center for Atmospheric Research, Boulder, CO). Annu. Rev. Astron. Astrophys.; 11: 187-218(1973).

Significant progress has been made over the past few years in computing stellar spectra by simultaneous solution of the transfer equations and the equations of statistical equilibrium. This approach avoids the a priori assumption of LTE, but presents difficult mathematical and physical problems, and requires extensive atomic data. Therefore much preliminary work has had to be devoted to methodological development and the study of simplified problems. Only recently have solutions of sufficient realism to allow comparison with real spectra been obtained. The most complete calculations are reviewed. (WDM)

22302 PROCESSES IN COLLAPSING INTERSTELLAR CLOUDS. Larson, R. B. (Yale Univ., New Haven). Annu. Rev. Astron. Astrophys.; 11: 219-238(1973).

An attempt is made to provide a brief summary of the current understanding of the processes occurring in collapsing interstellar clouds. Topics considered include formation of dense clouds and the onset of gravitational collapse, thermal properties of collapsing clouds, magnetic fields, dynamics of early collapse, effects of rotation, fragmentation and the stellar mass spectrum, evolution of protostars, observations of collapsing clouds and protostars, formation of planetary systems, formation of massive stars and H II regions, and molecular processes in collapsing clouds. (WDM)

22303 EXPLOSIVE NUCLEOSYNTHESIS IN STARS. Arnett, W. D. (Univ. of Texas, Austin). Annu. Rev. Astron. Astrophys.; 11: 73-94(1973).

In the last few years a number of advances in theory and experiment have allowed a much better understanding of thermonuclear reactions in supernovae. This review is restricted to a consideration of recent quantitative investigations of explosive nucleosynthesis in stars. As a consequence, a number of active research areas are discussed only insofar as they affect explosive nucleosynthesis. (WDM)

22304 PHYSICAL PROPERTIES OF CARBON STARS. Wallerstein, G. (Univ. of Washington, Seattle). Annu. Rev. Astron. Astrophys.; 11: 115-134(1973).

Developments during the past 16 years are emphasized, and research on carbon stars that was reviewed by Bidelman (1956) only briefly is discussed. Topics covered include classification, effective temperatures, luminosities, radii, masses, surface gravity, model atmospheres, chemical composition, nucleosynthesis, evolution, and special carbon stars. (WDM)

22305 SPECIAL CLASSIFICATION. Morgan, W. W. (Univ. of Chicago); Keenan, P. C. Annu. Rev. Astron. Astrophys.; 11: 29-50(1973).

The validity of the MK system of spectral classification is reexamined, and a revised frame of reference is given for the early-type stars. A revision of the MK system for giants and supergiants of classes G, K, and M is also given. (WDM)

22306 SOME PECULIARITIES OF THE UV SPECTRA OF THE WR STARS. Nikitin, A. A.; Feklistova, T. Kh. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 39-44(1973). (In Russian).

Spectral schemes of C III, N IV, and O V as well as their laboratory spectra were used to study the possible structure of the uv spectra of WR stars. Laboratory and stellar ir spectra of C II, C III and other elements enable one to reveal some peculiarities of their uv spectra. (auth)

22307 POLARIMETRIC AND PHOTOMETRIC STUDIES OF VARIABLE STARS. Dombrovskii, V. A.; Polyakova, T. A.; Yakovleva, V. A. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 45-57(1973). (In Russian).

The results of polarimetric and photometric observations of variable stars μ Cep, V CVn, AK Peg, S CrB, V CrB, U Her, RY Tau, and T Tau are given. Time variations of polarization for all these stars are found. The correlation between the variations of polarization, brightness, and colors is not the same in all the cases. (auth)

22308 INTRINSIC POLARIZATION OF R Sct. Yakovleva, V. A. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 57-65(1973). (In Russian).

The results of UBV polarimetric observations of R Sct are discussed. The interstellar component of polarization is subtracted from the observed polarization. The largest amount of intrinsic polarization is observed before the deep light minima of the star. (auth)

22309 ATTEMPT TO DETECT THE POLARIZATION DIFFERENCE IN MOLECULAR BANDS AND THE CONTINUUM IN THE SPECTRA OF HIGH LUMINOSITY RED VARIABLES. Derviz, T. E.; Dombrovskii, V. A. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48: 65-71(1973). (In Russian).

A comparison is given of the polarization measurements in

molecular bands of TiO and continuum for V CVn, AK Peg, VY CMa, and μ Cep. Within the observational accuracy no differences in polarization in bands versus continuum are found. (auth)

22310 UVBY β PHOTOELECTRIC PHOTOMETRIC CATALOGUE. Lindemann, E.; Hauck, B. (Univ., Lausanne, Switzerland). Astron. Astrophys., Suppl. Ser.; 11: No. 2, 119-281(Aug 1973).

This catalog contains the homogeneous values for 7603 stars observed in the u v b y β photoelectric photometric system. (auth)

22311 IMPOSSIBILITY OF THE FREE PRECESSION OF A LIQUID MASS APPROACHING THE STATE OF RELATIVE EQUILIBRIUM. Antonov, V. A. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 150-152(1973). (In Russian).

It is demonstrated that the heterogeneous gravitating liquid mass in the state of relative equilibrium behaves like homogeneous system. (auth)

22312 NARROW-BAND INFRARED PHOTOMETRY OF BRIGHT STARS. Khozov, G. V.; Shalberova, V. V.; Danilova, L. V. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 80-85(1973). (In Russian).

The results of narrow-band infrared photometry of 63 bright stars are presented. The observations for 1.58 μ and 1.70 μ show the existence of an excess radiation due to a minimum in the H^- opacity. (auth)

22313 GG CASSIOPEIAE: AN ECLIPSING BINARY WITH UNRESOLVED OPTICAL COMPANION. Shulov, O. S. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 86-97(1973). (In Russian).

The results of observations of the eclipsing variable GG Cas are discussed. The results of two-color polarimetric and four-color photometric observations are given. These results together with Popper's spectral date suggest a composite structure of the variable. There are indications that the late type spectrum has nothing to do with the secondary star of the binary system. This spectrum is attributed to a less distant star projecting on the eclipsing system. The secondary star is assumed to be unobservable star of a late spectral type. The relative and absolute orbital elements are found. An attempt to estimate the intrinsic polarization of the binary's radiation is undertaken. Great uncertainties arise from interstellar polarization. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 22290 and 22352.

22314 ANGULAR DIAMETERS OF QUASARS OF UNUSUAL COLOUR. Browne, I. W. A.; Conway, R. G.; Davis, R. J.; Spencer, R. E.; Stannard, D.; Warwick, R. S. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature (London); 244: No. 5410, 19-20(6 Jul 1973).

It is stated that two neutral-coloured stellar objects, OH471 and OQ172, have been shown to be QSOs with redshifts of 3.40 and 3.53 respectively, and this has stimulated interest in other radio sources identified with stellar objects lacking the uv or blue colour excesses normally associated with quasars. A list of objects has been published which, though blue, show no uv excess, and a list has been prepared of sources identified with neutral coloured objects, including OH471 and OQ172. Sources of both types have been suggested to be possible high redshift QSOs. The present authors measured the radio angular diameters of the sources on both lists, and of four further objects that may possibly be similar. The latter objects, OJ287, W Com, ON235, and BL Lac, show no spectral lines, but resemble OH471 and OQ172 in colour. The observations were made at Jodrell Bank with the Mark II–Mark III interferometer, having a baseline of 23.8 km, giving a maximum projected spacing of 132,000 wavelengths at 1660 MHz, and the technique adopted is described in detail. Most of the sources were compact, with sizes probably <0.5 arc s. As a test of the suggestion that the objects are QSOs of unusual colour, comparison was made with a sample of QSOs having the characteristic uv excess. A table is presented for the sources giving predicted flux density, radio spectral type, measured visibilities, and structure, and the impression obtained is that angular size depends markedly on radio spectral index. On the other hand, the optical colour, whether characterised by U-excess, B-excess or neutral colour, appears to have relatively little connection with size of source. OH471 and OQ172 both showed angular sizes <1 arc s, implying a linear diameter <2.5 kpc. (UK)

22315 IMPROVED PARAMETERS FOR 15 SOUTHERN PULSARS. McCulloch, P. M. (CSIRO, Sydney); Komesaroff, M. M.; Ables, J. G.; Hamilton, P. A.; Rankin, J. M. Astrophys. Lett.; 14: No. 3, 169-170(1973).

Improved periods, dispersion measures, and slowing-down rates are given for a number of southern pulsars. (auth)

22316 PROGRESS IN X-RAY ASTRONOMY. Giacconi, R. (American Science and Engineering, Inc., Cambridge, MA). Phys. Today; 26: No. 5, 38-47(May 1973).

Results from Uhuru 9 OSO-7 and some rocket flights are reviewed in terms of the night sky in x rays, galaxies of the local group, galactic sources, Sco X-1 type sources, x-ray binaries, Cyg X-1, Cen X-3, and Her X-1. (WDM)

22317 X-RAY OBSERVATIONS OF PULSARS IN THE AREA OF THE CRAB NEBULA. Berthelsdorf, R.; Linke, R. A.; Novick, R.; Weisskopf, M. C.; Wolff, R. S. (Columbia Univ., New York). Astrophys. Lett.; 14: No. 3, 171-172(1973).

Data taken with an x-ray polarimeter pointed at the Crab Nebula were analyzed for pulsed phenomena. The Crab pulsar was observed and the data were searched for periodic pulsation at other frequencies. The pulsed emission from NP 0532 was also analyzed for polarization. (auth)

22318 X-RAY STUDIES OF THE CRAB NEBULA OCCULTATIONS, 1974–75. Palmieri, T. M. (Center for Nuclear Studies, Saclay, France). Sky Telesc.; 46: No. 3, 160-162(Sep 1973).

In 1974 and 1975 the Moon will pass in front of the Crab Nebula allowing high-resolution x-ray studies to be made. The observing procedures and current preparations are briefly reviewed. (WDM)

22319 OPTICAL PULSATIONS FOR HZ HERCULIS. Middleditch, J.; Nelson, J. (Univ. of California, Berkeley). Astrophys. Lett.; 14: No. 3, 129-133(1973).

Optical pulsations from HZ Her have now been detected on about 10 nights out of 22. These pulsations are weak (<0.2 per cent), variable in intensity and duty cycle, and occur near the Her X-1 pulsar frequency. Because of the unexpected variability of the results, a detailed discussion is presented. (auth)

22320 X-RAY EMISSION FROM WHITE DWARFS IN CLOSE BINARY SYSTEMS. Hoshi, R. (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 49: No. 3, 776-789(Mar 1973).

The generation of x-ray sources in close binary systems is studied. It is proposed that one of the stars in a white dwarf and it is accreting material from its companion. The entire treatment applies to the spherically symmetric and the stationary case. The model of this type accounts qualitatively for the observed nature of Sco X-1. (auth)

22321 RADIATION OF ELECTROMAGNETIC WAVES BY RELATIVISTIC CLUSTERS OF CHARGED PARTICLES. Eidman, V. Ya. (Scientific-Research Radiophysics Inst., Gorky, USSR). Astrophysics (Engl. Transl.); 7: No. 1, 78-81(1971).

Translated from Astrofizika; 7: No. 1, 135-142(1971).

A study was made of the radiation emitted by a cluster of charged particles moving with a velocity near the velocity of light. The results obtained were used to investigate the electromagnetic radiation of pulsars. (auth)

22322 ALL-SKY CATALOG OF STRONG RADIO SOURCES AT 408 MHz. Robertson, J. G. (Univ. of Sydney). Aust. J. Phys.; 26: No. 3, 403-416(Jun 1973).

A catalogue of 160 extragalactic radio sources stronger than 10 f.u. at 408 MHz was compiled by selecting sources from the Parkes and 3 CR surveys but adopting the most accurate values of flux density that were available. The sky coverage of 10.1 sr omitted only the galactic plane and Magellanic Cloud regions. The flux density scale due to Wyllie was used throughout. (auth)

22323 MEASUREMENTS OF SOURCE STRENGTHS AT 29.9 MHz. Finlay, E. A.; Jones, B. B. (Univ. of Sydney). Aust. J. Phys.; 26: No. 3, 389-402(Jun 1973).

A survey of the region of sky between declinations $-4°$ and $-64°$ was completed at a frequency of 29.9 MHz at the Fleurs Radio Observatory of the School of Electrical Engineering, University of Sydney. Aperture synthesis was used to form a beam of 0.8° diameter. The flux densities of 175 sources were measured and referred to absolute measurements of certain strong sources. Most of the source fluxes were consistent with an extrapolation of the power law spectra determined from high frequency measurements but a few showed significant deviations. Absorption by the interstellar medium of sources at low galactic latitudes was only observed for $|b| < 3°$ and appeared to be negligible at higher latitudes. (auth)

22324 8-8 GHz RADIO OBSERVATIONS OF 12 SUGGESTED SUPERNOVA REMNANTS. Dickel, J. R.; Milne, D. K.; Kerr,

A. R.; Ables, J. G. (CSIRO, Epping, Australia). Aust. J. Phys.; 26: No. 3, 379-388(Jun 1973).

Brightness distributions and flux densities at 8.8 GHz are presented for 12 small-diameter radio sources near the galactic plane. Each of these sources has been classified at one time or another as a supernova remnant. For one source, G295.2−0.6, the flux density at 8.8 GHz confirms the thermal spectrum suggested by lower frequency measurements and indicates that it is not a supernova remnant. Another source, G309.6 + 1.7, is thought to be extragalactic. (auth)

22325 RADIO SOURCE COUNTS AT 408 MHz. Mills, B. Y.; Davies, I. M.; Robertson, J. G. (Univ. of Sydney). Aust. J. Phys.; 26: No. 3, 417-425(Jun 1973).

Radio source counts at 408 MHz were investigated using the data from the first Molonglo catalogue (MC1) and an all-sky catalogue of strong sources. Earlier results were qualitatively confirmed. Possible explanations of the high exponent of the number−flux density relation between sources of strong and intermediate flux density are discussed briefly, but no firm conclusions seem possible. (auth)

22326 GAMMA-RAY PULSES FROM THE CRAB NEBULA. Kinzer, R. L.; Share, G. H.; Seeman, N. (Laboratory for Cosmic Ray Physics, Naval Research Laboratory, Washington, D.C.). Astrophys. J. 180: No. 2, 547-549 (1 Mar 1973).

Evidence is presented for a pulsed flux of γ-rays between 5 and 25 MeV. Possible significant features in the pulse structure appear at 0.5-ms resolution. (auth)

22327 OBSERVATIONS OF VARIABILITY IN OJ 287. Goldsmith, S.; Weistrop, D. (The Florence and George S. Wise Observatory, Department of Physics and Astronomy, Tel-Aviv University, Israel). Astrophys. J. 180: No. 2, 661-664 (1 Mar 1973).

Photographic observations in V and B of the radio source OJ 287 have been made in 1972 February-May. The shortest period in which the variations were looked for was 5 minutes. On a timescale of days OJ 287 seems to have periods of intensive activity, variations of 0.3 mag, and periods of inactivity. The data do not indicate variations over a period of minutes. (auth)

22328 MILLIMETER-WAVELENGTH RADIO-ASTRONOMY TECHNIQUES. Penzias, A. A.; Burrus, C. A. (Bell Telephone Labs., Inc., Holmdel, NJ). Annu. Rev. Astron. Astrophys.; 11: 51-72(1973).

The coherent techniques that are being employed successfully to extend the short-wavelength boundaries of high-sensitivity radio astronomy are reviewed. Potentially useful new devices and techniques for the same application are also considered. Incoherent detection techniques are not discussed. (WDM)

Solar Phenomena

Refer also to abstracts 22386 and 22391.

22329 (AD-743294) OBSERVATIONS OF THE SOLAR OSCILLATORY COMPONENT AT A WAVELENGTH OF 3 mm. Report for September 1969−May 1970. Shimabukuro, F. I.; Simon, M. (Aerospace Corp., El Segundo, Calif. Electronics Research Lab; State Univ. of New York, Stony Brook. Dept. of Earth and Space Sciences). 17 Apr 1972. Contract F04701-71-C-0172. 19p. (SAMSO-TR-72-126). NTIS.

The solar oscillatory component has been observed at a wavelength of 3 mm by its modulation of the solar free−free emission. Observations were carried out separately at 3.3 and 3.5 mm with two different radio telescopes to rule out possible instrumental and atmospheric effects. Power spectra of the data show that the strongest spectral component is at 0.0055 Hz (period: 180 sec). These observations indicate that it is possible, by radio techniques, to extend observations of the solar oscillatory component to greater heights in the solar atmosphere than those previously observed in photospheric and low chromospheric spectral lines. (auth)

22330 (BNL-17945) EXPERIMENTAL LIMITS ON EXTRATERRESTRIAL SOURCES OF NEUTRINOS. Davis, R. Jr.; Evans, J. C. (Brookhaven National Lab., Upton, N. Y.). 1973. 6p. (CONF-730804-1). Dep. NTIS $3.00.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

The Brookhaven solar neutrino experiment has shown that the total flux-cross-section product of neutrinos from the Sun is less than 10^{-36} sec^{-1} ^{37}Ar atom. The experimental data can be used to search for steady and pulsed sources of neutrinos in the Galaxy. The detector uses 610 tons of C_2Cl_4 and neutrino detection depends upon the $^{37}Cl(\nu,e^-)^{37}Ar$ reaction that has a threshold of 0.814 MeV. The experiment has been in operation during the period 1968−1973, and 16 experimental runs have been performed. During the period 1970−1973 the sensitivity was increased so that it is possible to observe 10 atoms of ^{37}Ar in the detector, and during this period 8 experimental runs were performed. The individual experiments are presented and the results used to estimate limits on the steady neutrino flux or possible pulsed sources of neutrinos. The $\Sigma\phi\sigma$ limit noted above corresponds to the following limits on the energy density of neutrinos of specific energy in eV · cm^{-3}: 1 MeV − 54,000; 5 MeV − 2,500; 10 MeV − 90; 100 MeV − 3. (auth)

22331 (TRITA-EPP-73-7) ALFVEN WAVES IN SPIRAL INTERPLANETARY FIELD. Whang, Y. C. (Kungliga Takniska Hogskolan, Stockholm (Sweden)). Mar 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

This paper presents a theoretical study of the Alfvén waves in the spiral interplanetary magnetic field. The Alfvén waves under consideration are arbitrary, large amplitude, nonmonochromatic, microscale waves of any polarization. They superpose on a mesoscale background flow of thermally anisotropic plasma. Using WKB approximation, an analytical solution for the amplitude vectors is obtained as a function of the background flow properties: density, velocity, Alfvén speed, thermal anisotropy, and the spiral angle. The necessary condition for the validity of the WKB solution is discussed. The intensity of fluctuations is calculated as a function of heliocentric distance. The relative intensity of fluctuations compared with the magnitude of the background field has its maximum in the region near 1 AU. Thus outside of this region, the solar wind is less turbulent. Due to attenuation of microscale Alfvén waves, fluctuation energy is converted into the kinetic energy of the solar wind. Its contribution amounts to about 20% of the kinetic energy at 1 AU. (auth)

22332 ENRICHMENT OF SOLAR COSMIC RAYS WITH HEAVY NUCLEI. Konyakhina, S. S.; Kurnosova, L. V.; Logachev, V. I.; Razorenov, L. A.; Fradkin, M. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 149-150(1973).

Translated from Kosm. Issled.; 11: No. 1, 162-163(1973).

The ratio of the fluxes of different groups of solar cosmic-ray nuclei is briefly reviewed. (WDM)

22333 CONCERNING SOLAR NEUTRINOS. Shchepkin, M. G. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 4, 162-166(20 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 226-230(20 Feb 1973).

A possible explanation of the discrepancy between the theoretical predictions and the results of the observation of the neutrino flux from the Sun is considered. The initial assumption is that the temperature of the internal layers of the Sun varies periodically with time. Under certain conditions, a situation is possible wherein the luminosity of the Sun begins to vary sharply with time, and the photon luminosity remains practically constant. (auth)

22334 SUNSPOTS IN THE YEAR 1971. Mergentaler, J. (Astronomical Observatory, Wroclaw). Acta Geophys. Pol.; 21: No. 2, 165-167(1973). (In English and Polish).

Visual observations of the photosphere for 1971 are presented in tabular form. Observers and Wolf numbers are given. (WDM)

22335 CHROMOSPHERE-CORONA TRANSITION ZONE: A PROBLEMATIC REGION OF THE SOLAR ATMOSPHERE. Rozelot, J. P. (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France). Astronomie; 87: 234-240(Jun 1973). (In French).

The existence, morphology, thickness, and thermal equilibrium of the chromosphere−corona transition zone are discussed. (FR)

22336 SATELLITE MEASUREMENTS OF THE CHARGE COMPOSITION OF SOLAR COSMIC RAYS IN THE $6 \leq Z \leq 26$ INTERVAL. Teegarden, B. J.; von Rosenvinge, T. T.; McDonald, F. B. (Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 180: No. 2, 571-581 (1 Mar 1973).

We report measurements of the charge composition of solar cosmic rays during two flares occurring in 1971 April and September. The results were derived from a solid-state dE/dx versus E telescope which was part of the Goddard cosmic-ray experiment on the IMP-VI spacecraft. Our data suggest that the helium-to-medium ratio may be varying from one flare to the next. We compare our abundance ratios (normalized to oxygen) with measurements of other investigators and find a number of significant disagreements. In particular, our data do not exhibit any systematic enhancement of heavy nuclei with respect to the spectroscopic abundances such as reported by Mogro-Campero and Simpson. Finally, we compare our results with the spectroscopically determined coronal and photospheric values, and again we find several important differences between the two sets of data. (auth)

22337 INTERMEDIATE-COUPLING LINE STRENGTHS IN THE IRON SPECTRUM AND THE SOLAR ABUNDANCE OF

IRON. Ross, J. E. (University of California, Los Angeles). Astrophys. J. 180: No. 2, 599-606 (1 Mar 1973).

Line strengths for the $3d^64s^2$–$3d^64s(^6D)4p$ resonance transitions in Fe I are computed in intermediate coupling. The absolute gf-scale is set by the well-established λ3720 gf-value. For lines permitted in LS coupling, gf-values computed in intermediate coupling are in excellent agreement with recent experimental data and a considerable improvement over gf-values computed in LS coupling is obtained. (auth)

22338 MEASUREMENTS OF THE IRON-GROUP ABUNDANCE IN ENERGETIC SOLAR PARTICLES. Bertsch, D. L.; Fichtel, C. E.; Pellerin, C. J.; Reames, D. V. (NASA/Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 180: No. 2, 583-589 (1 Mar 1973).

The abundance of iron-group nuclei in the energetic solar particles was measured twice in the 1971 January 24 event and once in the 1971 September 2 event. Including earlier results from the 1966 September 2 event, the experimental series being discussed in this article has found the iron-group abundance to be in the range from 3–6 percent of the oxygen nuclei in the energy interval from 21 to 50 MeV per nucleon, in those events where the iron-group abundance could be measured. Iron-nuclei have a different charge-to-mass ratio from that of the C, N, O nuclei, so small variations in the Fe abundance in solar particles are not unexpected due to rigidity-dependent propagation effects and possibly rigidity-dependent acceleration. In the three exposures where the statistics were adequate to construct an energy spectrum, the iron-group nuclei were seen to have an energy per nucleon spectrum similar to that of the C, N, O nuclei; however, the energy per nucleon range was limited. The abundance for the iron-group nuclei mentioned above is consistent with the present solar spectroscopic abundance estimates. (auth)

22339 DIRECT MEASUREMENTS OF SOLAR-WIND FLUCTUATIONS BETWEEN 0.0048 AND 13.3 HZ. Unti, T. W. J.; Neugebauer, M.; Goldstein, B. E. (Jet Propulsion Laboratory, California Institute of Technology). Astrophys. J. 180: No. 2, 591-598 (1 Mar 1973).

Power spectra to a frequency of 13.3 Hz have been calculated from the OGO-5 Faraday cup measurements of the ion-charge flux of the solar wind. Twenty-five out of 32 spectra are fairly regular and are presented in linearized form. Their power levels and slopes are consistent with previously reported density spectra at much lower frequencies. The average slope of the log flux power versus log frequency lines is –1.6. The remaining seven spectra could not be closely approximated by straight lines due to additional power between 0.1 and 1.0 Hz, corresponding to convection past the spacecraft of small-scale irregularities. However, the statistical significance of the flattening of the spectra at these frequencies is usually borderline, and further observations and analysis are necessary to establish its reality and origin. (auth)

22340 NEUTRON MEASUREMENTS IN SPACE WITH OGO-VI. Ifedili, S. O. Durham, NH; Univ. of New Hampshire (1973). 261p. University Microfilms Order No. 73-16,742.

Thesis (Ph. D.).

An experiment was performed with a neutron detector on the OGO-VI satellite to search for solar neutrons, to measure the solar proton albedo neutron flux, and to determine the flux, latitude dependence, angular distribution, energy spectrum and the solar modulation of the cosmic-ray albedo neutrons. The upper limit on the quiet-time solar neutron flux from 1 to 20 MeV was measured to be less than 1.8×10^{-3} n/cm²-sec at the 95% confidence level. This result was deduced from the neutron detector measurements of the "day-night" effect near the equator at low altitudes for the period from June 7, 1969, to December 23, 1969. Limits, $<5 \times 10^{-2}$ n/cm²-sec in 1 to 20 MeV at the 95% confidence level, were placed on neutron emission from the Sun for several flares including two flares of importance 3B. The measurements were consistent with the Lingenfelter (1969) and Lingenfelter and Ramaty (1967) models for solar neutron production during solar flares. (TSS)

22341 TURBULENCE AND SCINTILLATIONS IN THE INTERPLANETARY PLASMA. Jokipii, J. R. (California Inst. of Tech., Pasadena). Annu. Rev. Astron. Astrophys.; 11: 1-28(1973).

As better models and more detailed observations have become available, it has become clear that fluctuations and waves are an essential aspect of the solar wind. It is now generally accepted that a detailed understanding of even the average properties of the interplanetary plasma depends on an understanding of fluctuations. It is the purpose of this review to consider both direct and indirect observations of these broadband fluctuations observed in the solar wind and, so far as is possible, to place the observations in some kind of overall perspective. (WDM)

Galaxies

22342 EQUILIBRIUM OF AN INTERSTELLAR MAGNETIC GAS CLOUD. Parker, D. A. Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 41-65(1973).

Equilibrium models are constructed of a cool, dense, interstellar gas cloud, surrounded by a hot tenuous H II region, and permeated by the locally distorted galactic magnetic field. The cloud is assumed to be axisymmetric, isothermal with a temperature of 75°K and to be of mass 10^3 $M_\odot$. The detailed solutions show that the cloud is oblate about its axis of symmetry and becomes highly flattened as the strength of the background magnetic field is increased. In an equatorial region the field exerts considerable pinching forces and in some models the field lines have snapped off, forming neutral rings. The effects of uniform rotation about the axis of symmetry of the magnetic field are examined. (auth)

22343 MAGELLANIC CLOUD INVESTIGATIONS. 4. The LMC Blue Globular Cluster NGC 1850. Tifft, W. G.; Connolly, L. P. Mon. Notic. Roy. Astron. Soc.; 163: No. 1, 93-103(1973).

A B, V photometric investigation of the Large Magellanic Cloud blue globular cluster NGC 1850 has been carried out. The study extends to V = 18. The cluster shows a strong blue main sequence and extensive numbers of evolved stars at both red and intermediate colours. The cluster appears to have an age close to 3×10^7 yr with turn-off point near eight solar masses. The evolutionary pattern conforms with theory and empirical studies of the somewhat older cluster NGC 1866. (auth)

22344 LONG BASELINE INTERFEROMETRY OF THE SEYFERT GALAXY 3C84. Legg, T. H.; Broten, N. W.; Fort, D. N.; Yen, J. L.; Bale, F. V.; Barber, P. C.; Quigley, M. J. S. (National Research Council of Canada, Ottawa). Nature (London); 244: No. 5410, 18-19(6 Jul 1973).

As part of a continuing programme to measure the visibility of radio sources and monitor the possible variability in their angular structure the visibility curve for 3C84 was determined in November 1972, and two possible interpretations are discussed. A long baseline interferometer was formed by the 45-m telescope at the Algonquin Radio Observatory in Canada and the 25-m telescope at the Chilbolton station in England. At the operating frequency of 10,680 MHz the baseline of 5,265 km represented a telescope separation of 187×10^6 wavelengths. Cooled parametric amplifiers, local oscillators locked to hydrogen masers and video tape recorders formed the essential components of the receiving systems. The techniques adopted are described and results discussed. The results supported an earlier conclusion that 3C84 is among those compact sources having exceptionally high magnetic fields. (UK)

22345 OH OBSERVATIONS OF A ROTATING DUST CLOUD. Crutcher, R. M. (Univ. of California, Los Angeles). Astrophys. Lett.; 14: No. 3, 147-152(1973).

A dust cloud in Taurus mapped by Kutner in the H_2CO line has been mapped in the 1667-MHz line of OH. The two distributions of molecular velocity, halfwidth, and antenna temperature correlate very well; also, the OH density correlates with optical extinction. Kutner's observation of an apparent cloud rotation has been confirmed. It is speculated that the cloud may be a high-density rotating disk which has contracted from a more typical interstellar cloud. (auth)

22346 STABILITY OF GRAVITATING SYSTEMS OF POINT MASSES. I. Cylinder of Finite Radius. Bisnovatyi-Kogan, G. S. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 7: No. 1, 70-77(1971).

Translated from Astrofizika; 7: No. 1, 121-133(1971).

The stability of an infinitely long rotating cylinder of bounded radius is investigated for various equilibrium distribution functions. The method of integration along trajectories is employed. Along the rotation axis the distribution function $f(v_z)$ proposed for a plasma by Jackson is considered; it enables the integrals to be evaluated analytically, with results otherwise similar to a Maxwellian distribution. This function is composed of two interpenetrating streams with equal thermal dispersions and an arbitrary relative velocity. If the thermal dispersion in z is sufficiently high, suppression of Jeans instability will automatically serve to suppress two-stream instability, whatever the relative velocity of the streams. Unlike the case in a plasma, where two-stream instability always sets in as the relative velocity increases, in a gravitating cylinder an increase in the relative velocity of the streams will tend to stabilize the system. (auth)

22347 THEORIES OF GALACTIC SPIRAL STRUCTURE COMPARISONS WITH OBSERVATIONS. Piddington, J. H.

(National Standards Lab., Sydney). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 73-89(1973).

The patterns of star creation which provide the optical spiral structure of galaxies have been attributed either to a gravitational (density-shock) or hydromagnetic origin; in the latter model gas clumping results from varying tilt of an oblique magnetic field. The predictions of the two theories are compared with observational data; in each theory the dust, young-star, and older-star arms are separated as observed. The major differences lie in the surface density and velocity distributions of cool gas; observations in M31, M33, and M101 seem to provide strong evidence against the density-shock theory. The 21-cm line profiles of H I in the Galaxy have not yet been correctly interpreted because of the neglect of velocity perturbations which rank in importance with density variations. Hence the line profiles favor neither theory; however, observed velocities V_z and shear DV/dz seem to be hydromagnetic. Observations of radio synchrotron emissions from M51, M31, and the Galaxy are either marginal or contrary to the density shock theory; a shock in the Galaxy should provide clear radio evidence, but this is not observed. Observational evidence indicates that some spiral galaxies do, and all may, have magnetic halos probably of primeval origin as required by the hydromagnetic theory. (auth)

22348 GAMMA-RAY EMISSION FROM THE REGION OF THE GALACTIC CENTER. Dahlbacka, G. H.; Freier, P. S.; Waddington, C. J. (School of Physics and Astronomy, University of Minnesota, Minneapolis). Astrophys. J. 180: No. 2, 371-379 (1 Mar 1973).

A combination nuclear-emulsion-spark-chamber γ-ray ($E > 100$ MeV) telescope has been used to study the region of sky that includes the Galactic center. Ninety-five percent confidence upper limits on the flux from the reported sources Gγ 2+3 and Sgr γ-1 were placed at 4.4 and 8.8×10^{-5} photons $cm^{-2}s^{-1}$, and a similar limit on the emission from the Galactic center as a point source ($\pm0.75°$) was placed at 3.3×10^{-5} photons $cm^{-2}s^{-1}$. No enhanced emission was observed from the Galactic plane ($\pm6°$), and an upper limit of 2×10^{-4} photons $cm^{-2}s^{-1}$ rad^{-1} was obtained. Three regions of enhanced emission were observed that had a combined Poisson probability of occurrence of less than 5×10^{-3}. One of these is associated with a region of enhanced emission reported by other workers. The observations were made against an integral atmospheric background intensity of 1.4 ± 0.4 photons cm^{-2} $sterad^{-1}$ s^{-1} mb^{-1} that had a spectral index of $0.8\pm$ in the energy range from 0.1 to 2.5 GeV. (auth)

22349 INTERSTELLAR GRAINS. Aannestad, A. (Goddard Space Flight Center, New York); Purcell, E. M. (Annu. Rev. Astron. Astrophys.; 11: 309-362(1973).

Topics covered in this review include interstellar extinction; spatial distribution of dust; theoretical extinction curves; scattering of light by grains; diffuse interstellar absorption lines; interstellar polarization; grain temperature and grain potential; grain alignment; processes on grain surfaces; x rays and interstellar grains; origin, growth, and destruction of grains; and dust in H II regions. (WDM)

22350 LIMITATIONS CAUSED BY THE STARS IN THE PHOTOGRAPHICAL DETECTION OF THE LOW BRIGHTNESS EXTENDED OBJECTS. Khristich, V. G. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 98-105(1973). (In Russian).

The limitations caused by both unresolved and resolved stars are discussed for the detection of the extended objects of low surface brightness using ordinary and composite photographs. (auth)

22351 CONSTRUCTION OF THE ROTATING STELLAR SYSTEM MODEL BY A NUMERICAL EXPERIMENT. II. Yakimov, S. P. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 141-149(1973). (In Russian).

A model of quasistationary rotating stellar system is constructed by numerical integration of the equations of motion for live bodies. The initial ratio of rotation energy to total kinetic energy is taken equal to 0.8. The distributions of density, centroid velocity and dispersions of peculiar velocities are obtained. The mean flattening of the model is 0.25. The rotation curve has several maxima. Similar fact is observed for a number of spiral galaxies. (auth)

22352 PHOTOGRAPHIC PHOTOMETRY OF COMPACT EXTRAGALACTIC OBJECTS. I. Babadzhanyants, M. K.; Gagen-Torn, V. A.; Kopatskaya, E. N.; Nebelitskii, V. B.; Polyanskaya, E. I. Uch. Zap. Leningrad. Gos. Univ., Ser. Mat. Nauk; No. 48, 72-80(1973). (In Russian).

Results are given of photographic photometry of compact extragalactic objects. The accuracy of the measurements is discussed. Several flares of QSS 3C 345 and N-galaxies 3C 371 and 3C 390.3 were observed in 1968-1970. The radius of the region responsible for the flare is estimated to be $R \leq (3 \text{ to } 8)\cdot10^{15}$ cm for 3C 371. (auth)

Cosmology

Refer also to abstracts 23297, 23340, and 23342.

22353 (ORO-3992-113) SOME PROBLEMS OF NATURAL PHILOSOPHY. Sudarshan, E. C. G. (Texas Univ., Austin. Center for Particle Theory). [nd]. 23p. (CONF-710123-1). Dep. NTIS $3.25.

From symposium on particle physics; Madras, India (4 Jan 1971).

A brief review of some outstanding unsolved problems of natural philosophy is given. The topics cover irreversibility, phase transitions, the ultimate constituents of the physical universe, biology, the aether, cosmology, and causality. (JFP)

22354 INTERNAL INSTABILITY IN A REISSNER-NORDSTROEM BLACK HOLE. Simpson, M.; Penrose, R. (Birbeck Coll., London). Int. J. Theor. Phys.; 7: No. 3, 183-197(Apr 1973).

The question of the effect of asymmetries in gravitational collapse is investigated by considerations of test electromagnetic fields in an extended Reissner-Nordstroem background. It is found, with the aid of computer calculations, that instabilities in the test field arise at the inner (Cauchy or anti-event) horizon, though not at the outer (event) horizon. Thus it is reasonable to infer that in the full coupled Einstein-Maxwell theory the inner horizon will not survive as a nonsingular hyperstructure when asymmetric perturbations are present, but will instead become a space-time curvature singularity. (auth)

22355 COMMENTS ON THE DIMENSIONALITY OF TIME. Mirman, R. (Long Island Univ., Brooklyn). Found. Phys.; 3: No. 3, 321-333(Sep 1973).

Some brief remarks are made on the relation between the ordering and dimensionality properties of time and the laws of physics. Time is defined as the ordinal of the set of photographs describing the configuration of the Universe associated with each collision of a test particle. This set of pictures is ordered by a parameter which appears in simple physical laws, and it is these laws which determine the ordering. Time is one-dimensional because these snapshots can be ordered with a single parameter. The signature of space-time appears to be related to the measurement process. If there were no time dimension, there would probably be no physical laws, because there would seem to be nothing to predict: while if there were more than one timelike dimension, then the extra dimensions may be unobservable and so physically nonexistent. (auth)

22356 COSMOLOGY VERSUS RELATIVITY: THE REFERENCE FRAME PARADOX. Prokhovnik, S. J. (Univ. of New South Wales, Sydney). Found. Phys.; 3: No. 3, 351-358(Sep 1973).

Two separate astronomical observations point to the existence of a preferred reference frame for the description of cosmological phenomena and laws. However, the existence of such a preferred frame appears to contradict the principle of relativity. It is suggested that if one assumes a hypothesis of McCrea, one can define a fundamental cosmological reference frame for energy propagation. In respect to all other reference frames, energy propagation will then not be isotropic. This anisotropy must affect the fields and the physical properties of material bodies associated with these "moving" frames, leading directly to the Fitzgerald contraction, time dilatation, and other anisotropy effects. The interaction of these interrelated absolute and observational effects renders all inertial observers Lorentz-equivalent such that the measured velocity of light appears identical with respect to all inertial systems; special relativity emerges as a fully intelligible theory, consistent with an observational cosmological reference frame. The result may be considered as a consequence of a generalized action-reaction law, and may also affect perturbation theory, relativistic thermodynamics, and quantum theory. (auth)

22357 UNIFIED QUANTUM ELECTRODYNAMIC ETHER. Wallace, B. G. Found. Phys.; No. 3, 381-388(Sep 1973).

The basic evidence and doctrines of physics and astronomy are examined and found to contain a simple, consistent unitary nature. It is proposed that all physical phenomena may be better explained in terms of a single physical entity if one accepts a conceptual advancement of presently accepted doctrine. The modification postulates that the inertial mass of matter is the same entity as the virtual mass of a photon and that a circular motion of speed c is transformed into a linear motion of speed c when mass is transformed into energy. The logical expansions of the modification seem to give simpler explanations for basic phenomena and the infinite and eternal nature of the Universe. (auth)

22358 REDSHIFTS IN ASTRONOMY. Grygar, J. Pokroky Mat. Fyz. Astron.; 18: No. 1, 18-26(1973). (In Czech).

Theories of various workers (without specific reference to

publications) concerning the gravitational redshift, the cosmological redshift (and its nonvelocity component), and quasar redshifts are discussed with reference to various galaxies. Graphs are presented showing the redshift in quasar spectra, including four quasars from the near galaxy NGC 520. (TTT)

22359 INVARIANT MECHANICAL STRUCTURE OF THE EXPANDING UNIVERSE. Ionescu-Pallas, N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 5, 671-676 (1973).

An approach is presented to the mechanical structure of the universe which proceeds from a kinematic basis and has some trends in common with the theory put forward by Milne. The departures from Milne's theory are however very important, the present theory confirming rather Einstein's line of reasoning. (WDM)

22360 BLACK HOLE AND NAKED SINGULARITY. Liang, E. P. T. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 7: No. 14, 599-602(4 Aug 1973).

The intrinsic differences between singularities which are hidden behind event horizons and those which are naked are considered. Some preliminary findings obtained after analyzing a larger number of known exact solutions are reported. A conjecture based on these results is then proposed. (WDM)

22361 CLOSED WORLDS CONTAINING THE SOURCES OF MASSIVE VECTOR FIELD. Markov, M. A.; Frolov, V. P. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 16: No. 1, 70-76(Jul 1973). (In Russian).

The presence of nonvanishing electrical charge in the world is incompatible with the closeness of the latter. The possibility of closed worlds with nonzero charge of massive vector field is proved. The analog of the electrodynamic Gauss theorem in the massive vector field theory is discussed. Systems with closed metrics are considered as limiting cases of black holes described by semi-closed metric. (auth)

22362 INTERACTION OF VORTEX AND POTENTIAL MOTIONS IN RELATIVISTIC HYDRODYNAMICS. III. Tiunov, E. A.; Chernin, A. D. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 7: No. 1, 94-96(1971).

Translated from Astrofizika; 7: No. 1, 161-165(1971).

The gravitational field in the general theory of relativity is determined not only by the distribution but also the motion of matter. In conformity with this, it can serve as the cause of relativistic interaction of hydrodynamic motions of a gravitating medium. Continuing the investigation by Chernin (1969) of nonlinear effects in relativistic hydrodynamics, one simple example of such interaction is considered. (WDM)

22363 WHY IS THE UNIVERSE ISOTROPIC?. Collins, C. B. (Department of Applied Mathematics and Theoretical Physics, Silver Street, Cambridge, England); Hawking, S. W. Astrophys. J. 180: No. 2, 317-334 (1 Mar 1973).

We examine the question of whether the present isotropic state of the universe could have resulted from initial conditions which were "chaotic," in the sense of being arbitrary, any anisotropy dying away as the universe expanded. We show that the set of spatially homogeneous cosmological models which approach isotropy at inifinite times is of measure zero in the space of all spatially homogeneous models. This indicates that the isotropy of the Robertson-Walker models is unstable to homogeneous and anisotropic perturbations. It therefore seems that there is only a small set of initial conditions that would give rise to universe models which would be isotropic to within the observed limits at the present time. One possible way out of this difficulty is to suppose that there is an infinite number of universes with all possible different initial conditions. Only those universes which are expanding just fast enough to avoid recollapsing would contain galaxies, and hence intelligent life. However, it seems that this subclass of universes which have just the escape velocity would in general approach isotropy. On this view, the fact that we observe the universe to be isotropic would be simply a reflection of our own existence. (auth)

22364 NEUTRON STARS AND BLACK HOLES IN OUR GALAXY. Ruffini, R. (Princeton Univ., NJ). Trans. N. Y. Acad. Sci.; 35: No. 3, 196-226(Mar 1973).

Topics covered in depth in this review include classical tests of general relativity, supernovae and collapsed objects, neutron stars, black holes, and gravitational radiation. (WDM)

22365 PHYSICAL PROCESSES NEAR COSMOLOGICAL SINGULARITIES. Novikov, I. D.; Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Annu. Rev. Astron. Astrophys.; 11: 387-412(1973).

Topics considered in this review include: inevitability of an initial singularity; structure of the singularity in uniform models; mixmaster model of the Universe; quantal limitations of the mixmaster model; structure of the singularity in the general solution; equations of state at ultra-high densities and temperatures; bounce in the Friedmann model; thermodynamic equilibrium; streaming of matter in homogeneous anisotropic models; weakly interacting particles in the anisotropic cosmological model; quantum corrections to the Einstein equations and the creation of particles; nonconservation of baryons near a singularity; entropy buildup in a perturbed Friedmann Universe (occurrence of clusters of galaxies); and perturbed isotropic and quasi-isotropic solutions. (WDM)

22366 DIFFUSE X AND GAMMA RADIATION. Silk, J. (Univ. of California, Berkeley). Annu. Rev. Astron. Astrophys.; 11: 269-308(1973).

An attempt is made to synthesize and update much of the earlier work, and to present a unified view of the diffuse x and γ radiation. Diffuse x and γ radiation over the energy range spanning soft x rays to hard γ rays is discussed. Each of the three spectral regions 0.25 keV, 20 keV and 1 MeV are discussed in detail, and the various theoretical models that have been proposed are reviewed. The contribution of diffuse galactic emission to the background is considered. (WDM)

22367 STANDARD MODEL OF THE EARLY UNIVERSE. Harrison, E. R. (Univ. of Massachusetts, Amherst). Annu. Rev. Astron. Astrophys.; 11: 155-186(1973).

This discussion covers the period of the early Universe during which the temperature is $10^{12} \geq T \geq 10^{3}$ K and the corresponding density and age of the Universe lies in the range $10^{14} \geq \rho \geq 10^{-20}$ g cm^{-3}, $10^{-4} \geq t \leq 10^{14}$ sec. The thermal history is outlined and facts and figures are given. The radiation era, lepton era, and origin of matter are considered. (WDM)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 21428, 22263, 23165, and 23236.

22368 (AD-743941) POLAR CAP SPECTRAL EMISSION INTENSITIES AND THEIR RELATIONSHIP TO SELECTED GEOMAGNETIC PARAMETERS. Final Report, 1 April–30 November 1971. Frey, J. H.; Fischer, W. L.; Miller, D. L. (Science Resources Foundation, Watertown, Mass. (USA)). 31 Mar 1972. Contract F19628-71-C-0179. 87p. (AFCRL-72-205). NTIS

Selected spectral emission data from the One Meter Fastie–Ebert Scanning Spectrometer located at the AFCRL Geopole Station, Thule, Greenland were scaled and analyzed. The autocorrelation power spectral density and diurnal variation of the emission were examined. Linear correlations were performed between emissions by month and UT hour, by season and by total data set. Linear correlations between emissions and selected geomagnetic parameters were also performed. The indeterminacy of results due to the occurrence of zeros in the data is discussed. (auth)

22369 (AD-757481) COMPUTER SIMULATION OF ION COLLECTION BY AN IONOSPHERIC PROBE. Final Report, 1 December 1971–1 January 1973. Vogenitz, F. W. (TRW Systems Group, Redondo Beach, Calif.). 1 Jan 1973. Contract F19628-72-C-0130. 82p. (AFCRL-TR-73-6). NTIS.

Monte Carlo calculations of positive ion collection by a flat faced cylindrical probe were carried out at speed ratio 1.5 over a range of λ_∞/D (neutral molecule mean free path/cylinder diameter) and λ_D/D (Debye length/D) at a fixed cylinder front face potential of −10 volts. Under collisionless conditions ($\lambda_\infty \gg D$) it was found that for $\lambda_D/D > 1.0$ the ion flux to the front face stagnation point was approximately 35 times the field-free ion flux. The stagnation point ion flux decreased rapidly as λ_D/D was reduced below 1.0, reaching a value of approximately 4 times the field free ion flux at $\lambda_D/D = 0.03$. The ion flux at $\lambda_D/D = 0.03$, when scaled to conditions for which flight data were available was found to be a factor of 4 higher than the flight measured flux. (NTIS)

22370 (AD-758733) THREE-DIMENSIONAL MODEL OF THE THERMOSPHERE WITH AURORAL HEATING. Vest, R. (Pennsylvania State Univ., University Park. Ionosphere Research Lab). 6 Feb 1973. Contract N00014-67-A-0385-0017. 80p. (PSU-IRL-SCI-412). NTIS.

A three-dimensional steady state model of the dynamics of the upper atmosphere is developed by the simultaneous solution of the equations of continuity, conservation of momentum, and conservation of energy over the entire upper atmosphere. Detailed consideration is given to the diffusion processes, the shear stresses, and the energy transport mechanisms, and to the thermal conductivity and viscosity effects in a multicomponent mixture. The resulting system of equations is solved by a digital computer to yield realistic values for the temperatures, densities, and nighttime winds in the upper atmosphere. The daytime winds are overestimated by about a factor of three, since the effects due to collisions with ionized components were neglected. A reasonable profile of the auroral heating input during solar storms is incorporated into the model and the effect produced by this heating on the upper atmosphere is evaluated. (auth)

22371 (TRITA-EPP-73-2) THEORY OF TIME VARYING ATMOSPHERIC ELECTRIC FIELDS AND SOME APPLICATIONS TO FIELDS OF IONOSPHERIC ORIGIN. Bostroem, R.; Fahleson, U.; Olausson, L.; Hallendal, G. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Jan 1973. 51p. Dep. NTIS (U. S. Sales Only) $4.75.

The propagation of slowly varying electric disturbances in the atmosphere is investigated theoretically. The approach used is to solve the continuity equation for the electric current assuming the electric field to be a time varying potential field. An earlier, quite generally quoted result that the temporal variation of the electric field at each point is governed by the local relaxation time is shown to be false, also for slow variations, except for very special geometries. Atmospheric fields of ionospheric origin are studied. A general analytical solution is presented and examples of numerically computed solutions are given. Models are considered where the electric field is a standing or travelling sinusoidal wave with frequencies in the range 0 to 0.5 Hertz, wavelengths $\geq 3 \times 10^4$m, and velocities 0 to 3500 m/s. Also considered are fields from moving ionospheric structures that are spatially confined with dimensions in the range 10 to 200 km. It is concluded that ionospheric field variations give rise to substantial disturbances in the atmospheric electric field, but at low altitudes they are hard to distinguish from disturbances of meteorological origin. It is shown that it is quite feasible to make balloon studies (altitudes 30 to 40 km) of slowly varying fields of ionospheric origin. However, it is difficult to study ionospheric field variations at frequencies higher than about 0.1 Hz or to resolve spatial structures smaller than about 100 km. (auth)

22372 LOCALIZATION OF SOURCES OF TWO-HOP WHISTLERS OBSERVED ABOARD THE INTERKOSMOS 3 SATELLITE OVER EUROPE. Jiricek, F.; Tixier, M. (Inst. of Geophysics, Prague). J. Atmos. Terrest. Phys.; 35: No. 9, 1705-1708(Sep 1973).

A study of vlf records obtained during October 1970 from some passes of the Interkosmos 3 satellite over the European area in connection with active thunderstorm centres is presented. It is deduced that there is a general possibility of observing fractional and two-hop whistlers when the initial lightning discharges are located at a distance less than 3000 to 4000 km. (auth)

22373 EFFECT OF GEOMAGNETIC DISTURBANCE ON THE DUCT PROPAGATION OF LOW-LATITUDE WHISTLERS. Tanaka, Y.; Hayakawa, M. (Nagoya Univ., Japan). J. Atmos. Terrest. Phys.; 35: No. 9, 1699-1703(Sep 1973).

A study has been made of the storm-time dependence of the frequency of occurrence, dispersion, and diffuseness of whistlers in the period January 1967 to December 1970 at Moshiri (geom. lat. 34°) and Sakushima (24.1°). At Moshiri whistler occurrence and diffuseness have a maximum and the dispersion a minimum for 1 or 2 days following a disturbed day ($\Sigma K \geq 30$). At Sakushima there is a similar increase in the frequency of occurrence, however, there is a less evident dependence of dispersion on storm-time. The enhanced diffuseness is attributed to an increase in the effective width of the duct region consisting of many elemental ducts. (auth)

22374 REFLECTION COEFFICIENTS OF HYDROMAGNETIC WAVES FROM CONJUGATE IONOSPHERES. Van'yan, L. L.; Kozhevnikov, A. A.; Turbin, Yu. G. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 137-139(1973).

Translated from Kosm. Issled.; 11: No. 1, 152-154(1973).

In order to explain the mechanism of generation of short-period pulsations, an attempt is made to understand the fundamental laws for the propagation of hydromagnetic waves in a magnetospherical plasma and their interaction with a gyrotropic ionosphere. (WDM)

22375 DIRECT MEASUREMENTS OF THE ELECTRICAL CONDUCTIVITY AND RELAXATION TIME OF IONIZED AIR IN THE STRATOSPHERE AND MESOPHERE. Bragin, Yu. A.; Kocheev, A. A.; Bragin, O. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 110-114(1973).

Translated from Kosm. Issled.; 11: No. 1, 124-129(1973).

The first continuous altitude profiles of air conductivity in the stratosphere and mesosphere are derived, obtained by means of the direct measurement of this quantity by the method of an open dispersive body. The principles of the method are given. (auth)

22376 INVESTIGATION OF GEOACTIVE CORPUSCLES AND PHOTOELECTRONS WITH THE KOSMOS 261 SATELLITE. V. Spectra of Ionospheric Photoelectrons and Their Transfer From the Conjugate Ionosphere. Gal'perin, Yu. I.; Vernik, A.; Dymek, M.; Kutiev, I.; Mulyarchik, T. M.; Serafimov, K. B.; Shuiskaya, F. K.; Shulenina, R. V. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 90-100(1973).

Translated from Kosm. Issled.; 11: No. 1, 101-112(1973).

During the summer of 1970 the Kosmos 348 satellite measured the energy spectra of ionospheric photoelectrons in the range 30 to 150 eV with a resolution $\Delta E/E = 0.2$ The averaged spectrum can be approximated by a pair of exponential curves with characteristic values $E_{01} = 10$ eV at energies of 30 to 85 eV and $E_{02} = 28$ eV in the range 85 to 150 eV. The energy at which the slope changes remains relatively constant within the experimental error, at a value 85 ± 10 eV. According to measurements at the dark end of the tube of force, the spectrum of photoelectrons arriving from above from the conjugate illuminated ionosphere differs in shape from the average daytime energy spectrum, with a considerable reduction in the intensity of electrons of 30 to 50 eV. These lower-energy electrons moreover exhibit a strong scatter from the loss cone at high pitch angles, leading to isotropization. This implies that some unidentified type of (non-Coulomb) scattering mechanism exists

which is more efficient at low energies. Presumably this special type of scattering prevented the appearance of photoelectron quasicapture during the period of observation, whereas during the 1962 flight of Kosmos 5 (at greater heights) quasicapture of photoelectrons was definitely observed. A comparison is made between the spectra of upward-moving photoelectrons escaping from the ionosphere beneath the satellite and the spectra of downward-moving photoelectrons travelling along the tube of force from the conjugate ionosphere. Since the energy spectrum exhibits a characteristic change of slope, this comparison enables one to measure the potential difference between the ends of the tube of force (in the F region of the ionosphere) at intermediate latitudes. The June 17, 1970 measurements indicate that the potential difference is no more than 10 V. If it is assumed that no potential wells symmetric about the equatorial plane exist, then it is found that the strength of the parallel electric field is $\epsilon_{||} \leq 10^{-8}$ V/cm. This value is considerably lower than the critical Dreiser field $\epsilon_C \approx 10^{-6}-10^{-7}$ V/cm for the appearance of runaway electrons. Earlier estimates had placed an upper bound of only 10^{-7} V/cm on the electric-field strength. (auth)

22377 IONOSPHERIC STUDIES CONDUCTED BY THE SATELLITE INTERCOSMOS 2. I. Gringauz, K. I.; Serafimov, K. B.; Shmelovskii, K. G.; Shmilauer, Ya. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 85-89(1973).

Translated from Kosm. Issled.; 11: No. 1, 95-100(1973).

Basic data are presented on the satellite Intercosmos 2, the scientific apparatus aboard, the organization of the entire experiment, and processing of data obtained. Experiments were conducted with spherical ion traps, cylindrical Langmuir probes, and a "Mayak" two-frequency coherent radio transmitter. The general characteristics of the results are presented. (auth)

22378 DIRECT MEASUREMENTS OF PLASMA CONVECTION IN THE UPPER IONOSPHERE. Gal'perin, Yu. I.; Ponomarev, V. N. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 79-84 (1973).

Translated from Kosm. Issled.; 11: No. 1, 88-94(1973).

Results of direct measurements of the rate of convection (rate of ion drift in the horizontal plane are reported for the circumpolar and polar upper ionosphere at heights ~630 km, obtained with the Kosmos-184 satellite during the Nov. 4, 1967 moderate magnetic disturbance. (WDM)

22379 ASPHERICAL MODEL FOR THE UPPER-ATMOSPHERE DENSITY. Voiskovskii, M. I.; Volkov, I. I.; Gryasev, N. I.; Kugaenko, B. V.; Sinitsyn, V. M.; El'yasberg, P. E. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 62-70(1973).

Translated from Kosm. Issled.; 11: No. 1, 70-79(1973).

An analytic model is constructed for the density in the aspherical upper atmosphere according to observations of the motion of the Soviet Kosmos satellites. The diurnal and semiannual density variations are taken into account, as well as the dependence of the density on solar activity and geomagnetic disturbance. The model is applicable for predicting satellite motion in the height range 160 to 600 km. Since the experimental data on which the calculation is based contain information on the density variation at heights of 160 to 300 km, Jacchia's 1970 model has been employed to determine the model parameters at greater heights. The model developed here is compared with the CIRA-65 and Jacchia's models. Furthermore, an a posteriori estimate is obtained for the gain in the accuracy of predicting satellite motion when the present model is used rather than a spherically symmetric model. (auth)

22380 SIMULTANEOUS OBSERVATIONS OF Pcl MICROPULSATION POLARIZATION AT FOUR LOW LATITUDE SITES. Fraser, B. J. (Univ. of Colorado, Boulder); Summers, W. R. Ann. Geophys.; 28: No. 4, 697-708(1972).

Polarization studies of hydromagnetic micro-pulsation Pcl type emission in the plane of the Earth's surface were undertaken using a four station network in Southeast Australia and New Zealand. Four linear polarized events are considered and it is shown that during the nighttime, when the ionospheric duct is relatively uniform, the ellipse major axis direction is related to a high-latitude ionospheric source region. Propagation from an extended source region and irregularities in the duct, caused by the approach of sunrise, may contribute to interstation variations in polarization parameters. (FR)

22381 EQUATORIAL SPREAD-F OVER A SOLAR CYCLE. Chandra, H.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Ann. Geophys.; 28: No. 4, 709-716(1972).

The average nocturnal variations of spread F at stations close to the magnetic equator are studied for different seasons of the years of varying solar activity. They are compared with the corresponding variations of the F-layer height (h'F). The spread F at any station reaches a maximum value before midnight during high sunspot years and after midnight during low sunspot years. The maintenance of high spread F during the night of local summer months is not due to larger height rise but arises because of the maintenance of the F region at higher levels for a longer period of night. The decrease of spread F during magnetically disturbed days is only clearly evident during high sunspot years. During low sunspot years effect is not significant. (FR)

22382 SUDDEN DISAPPEARANCE OF E_s-q AND THE REVERSAL OF THE EQUATORIAL ELECTRIC FIELDS. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Ann. Geophys.; 28: No. 4, 717-728(1972).

The sudden disappearance of equatorial q type sporadic E associated with decreases in the geomagnetic H component was shown to occur simultaneously at stations separated by a few hundred km in the N–S direction and a few thousand km in the E–W direction. The E_s-q is shown to disappear precisely for the duration when the H field is below its normal nighttime level provided proper corrections are applied for the D_{st} value. There is no apparent relation between the H field and f_0E_s during midday hours; the E_s-q has either the normal high f_0E_s value or is completely absent. The disappearances and reappearances of E_s-q are very closely correlated with increases and decreases in the H field above a threshold value and with the switching on and off of the eastward electric field at the magnetic equator. The E_s-q is suggested to be indicative of cross-field plasma instability in the equatorial electrojet region. Disappearances in E_s-q are believed to be due to a sudden vanishing or reversal of the horizontal electrostatic field by the superimposition of an additional westward electric field over the normal eastward S_q field. The change in the electric field direction has an almost immediate (less than 3 minutes) effect on the occurrence of E_s-q. (FR)

22383 OBSERVATIONS ON AIRGLOW GREEN CELLS. Battaner, E.; Pardo, G. (Univ., Granada, Spain). Ann. Geophys.; 28: No. 4, 731-734(1972).

Average values for the diameter, speed, brightness, and other characteristics of 5577A airglow cells were measured in the Sierra Nevada (Spain). The measurements were made when a cell was present over the station as determined from isophote patterns in UT/distance on the meridional plane diagrams. Brightness distributions within the cell were obtained which seem to indicate a material displacement. (FR)

22384 LABORATORY METHODS FOR STUDY OF AERONOMICAL REACTIONS OF EXCITED IONS. Vinogradov, P. S.; Karachevtsev, G. V.; Marutkin, A. Z.; Tal'rose, V. L.; Hovanskii, Yu. K. (Inst. of Chemical Physics, Hovanskii, Yu. K. (Inst. of Chemical Physics, Moscow). Ann. Geophys.; 28: No. 4, 859-862 (1972).

Methods for studying reactions involving excited ions are examined. The technique of measuring the kinetic energy of ions at high pressure in the ion chamber of a mass spectrograph (several collisions in the chamber) is used to estimate the rate of vibrational translational de-excitation of NO^+ ions during collisions between Xe atoms. The constant K_d lies in the $0.083.10^{-9}$ to $0.38.10^{-11}$ cm^3 sec^{-1} range corresponding to a probability W_d lying between 0.1 and 0.05. The technique is used to estimate the rotational energy of the NO^+ formed in dissociative ionization. The beam technique and the technique of measuring the internal excitation of ions formed in ion–molecule reactions are envisaged to study the manner in which the electron/ion recombination cross section depends upon the internal ion excitation. (FR)

22385 PROTONOSPHERE–IONOSPHERE COUPLING: NEW BACKSCATTER OBSERVATIONS AT ARECIBO, PUERTO RICO. Hsu, P. Y. S. Cleveland; Case Western Reserve Univ. (1973). 193p. University Microfilms Order No. 73-16,133.

Thesis (Ph. D.).

The coupling between the normal F-region ionosphere and the protonosphere is being experimentally investigated using the radar backscatter techniques at Arecibo, Puerto Rico. The experiments yield vertical transport velocity, electron density, ion composition, electron and ion temperature, spanning the complete altitude range from 170 to 1854 Km., well into the protonosphere. The results of this research are concerned with two nighttime periods on Feb. 10–11, and Feb. 24–25, 1972. The first night was quite in contrast to the dynamic nature of the second night when the usual midnight collapse was observed. (TSS)

22386 NEW EVIDENCE FOR EFFECTS OF VARIABLE SOLAR CORPUSCULAR EMISSION ON THE WEATHER. Roberts, W. O. (University Corp. for Atmospheric Research, Boulder, CO); Olson, R. H. Rev. Geophys. Space Phys.; 11: No. 3, 731-740(Aug 1973).

New evidence supports some earlier findings of connections between solar activity and weather that involve streams of solar corpuscular emission. The time lag between the arrival of the solar streams and their first lower stratospheric or tropospheric response is about three days, and the effects appear to be most

pronounced in winter. No fully plausible physical explanation is known, but some speculations are advanced regarding a possible heating mechanism for the upper troposphere that results from aurora-induced cirrus clouds over the relatively warm Gulf of Alaska. (auth)

22387 HORIZONTAL VARIATIONS IN THERMOSPHERIC COMPOSITION. Johnson, F. S. (Univ. of Texas, Dallas). Rev. Geophys. Space Phys.; 11: No. 3, 741-754(Aug 1973).

Constant boundary conditions at 120 km have been so widely and successfully used in atmospheric modeling and in fitting atmospheric density data obtained from satellite drag to models that attention has been diverted from the variations that occur at 120 km, especially in composition. Atomic oxygen concentrations vary by factors as large as 4, with highest concentrations occurring in the winter hemisphere but at mid-latitudes rather than over the polar region. A substantial additional degree of variability occurs that is especially associated with geomagnetic activity. The helium concentration varies by about an order of magnitude between poles, with the maximum concentration occurring at high winter latitudes and a secondary minimum occurring over the winter pole. (auth)

Effects of Nuclear Detonations

22388 (AD-757994) APPROACHES TO COMPUTER MODELING OF ATMOSPHERIC NUCLEAR EFFECTS. Final Report. Boris, J.; Brown, J.; Coffey, T. (Naval Research Lab., Washington, D. C.). Jan 1973. 23p. (NRL-MR-2541). NTIS.

The relatively distinct approaches to computer modeling of the fluid like aspects of nuclear-explosion phenomenology in the upper atmosphere are compared, with heavy emphasis laid on the problems associated with constructing a successor code to RANC. Each of the five methods is scored on 16 indices comprising four general criteria: survivability, validity of results, ease of use, and required computer resources. Highest overall scores were obtained by the system-like approaches to analytic and quasi-analytic modeling. The lowest scores were obtained by the detailed physics approaches. (auth)

Magnetospheric Phenomena

Refer also to abstracts 22240 and 22933.

22389 (TRITA-EPP-72-22) INFLUENCE OF THE IONOSPHERE ON MAGNETOSPHERIC FLOW. I. Karlson, E. T. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Dec 1972. 39p. Dep. NTIS (U.S. Sales Only) $4.00.

In the first paper of this series (Karlson 1971), a two-dimensional model of stationary, adiabatic plasma flow in the magnetosphere was studied. The interaction of magnetospheric flow with the ionosphere was neglected. The aim of the present paper is to give a model of stationary adiabatic plasma flow in the magnetosphere, where the interaction with the ionosphere is taken into account. It is pointed out that in a self-consistent model of magnetospheric flow there must be either field-aligned currents, or longitudinal electric fields, or both. One extreme case would be when the field-aligned currents are negligible. It is shown here that the treatment in the first paper of this series solves this problem for the magnetosphere. In the opposite extreme case, where the longitudinal electric fields are negligible, it is necessary to use an iterative procedure to find the solution. The importance of the choice of an optimal lowest order solution is stressed, and it is shown how an estimate of the field-aligned currents can be used to find such a solution. The resulting flow is compared with the flow found with the assumption of no field-aligned currents, and the similarity of the flows for these two extreme cases makes it possible to draw conclusions about the intermediate situation found in nature. The solution to next order, as well as a discussion of the possibility that observed features of the magnetosphere can be understood in terms of stationary, adiabatic plasma flow will be given in another report. (auth)

22390 (UCRL-74856) PITCH-ANGLE DISTRIBUTIONS OF ENERGETIC ELECTRONS IN THE EQUATORIAL REGIONS OF THE OUTER MAGNETOSPHERE: OGO-5 OBSERVATIONS. West, H. I. Jr.; Buck, R. M. (California Univ., Livermore. Lawrence Livermore Lab.). 9 Jul 1973. 14p. (CONF-730825-1). Dep. NTIS.

From Earth's particles and fields summer advanced study institute conference; Sheffield, UK (13 Aug 1973).

An overall view of pitch-angle distributions of energetic electrons throughout the equatorial regions of the magnetosphere is presented. Subtle pitch-angle effects are not considered, but rather, the data is presented in terms of three broad categories: normal, butterfly, and isotropic. (WDM)

22391 SECTOR-PATTERNED STRUCTURE OF INTERPLANETARY MAGNETIC FIELD AND MAGNETIC DISTURBANCES IN THE CIRCUMPOLAR REGION. Sumaruk, P. V.; Fel'dshtein, Ya. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 140-146(1973).

Translated from Kosm. Issled.; 11: No. 1, 155-160(1973).

Magnetic field variations reported at high-latitude northern-hemisphere observatories in the 1965 summer period were compared to the components of the interplanetary magnetic field in the plane of the ecliptic with respect to direct measurements taken by instruments mounted on the IMP-3 satellite. (WDM)

22392 ACCURACY OF L- AND B-COORDINATE CALCULATIONS. Trebukhovskaya, G. A.; Golynskaya, R. M.; Osipova, L. N. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 101-105(1973).

Translated from Kosm. Issled.; 11: No. 1, 113-118(1973).

Analysis of the error in computing the flux density of a magnetic field B and the invariant shell parameter L on the basis of a program encoded in machine language for the BESM-4 digital computer is discussed. It is found that the maximum error is due to an error in the representation of the intensity of the field at a given point in space in some system of coefficients in the series expansion of the geomagnetic field in spherical functions. The article offers a relative and an absolute comparison of different systems of coefficients. (auth)

22393 RADIATION DOSE DISTRIBUTION IN THE EARTH'S RADIATION BELTS DURING YEAR OF MAXIMUM SOLAR ACTIVITY. Savun, O. I.; Senchuro, I. N.; Shavrin, P. I.; Shumshurov, V. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 106-109 (1973).

Translated from Kosm. Issled.; 11: No. 1, 119-123(1973).

The radiation dose distribution is presented for a shielding of ~ 0.7 g/cm^2 in the inner and outer radiation belts, obtained using an ionization chamber on the satellite Molniya 1. The dose absorption distribution can be considered typical for geomagnetically quiet periods of the year, close to the solar activity maximum (January, 1971). The maximum dose rate in the center of the inner belt is ~ 520 rad/day for shielding of ~ 0.7 g/cm^2 from 4π steradians and ~ 130 rad/day in the outer belt. The maximum dose rate in the center of the inner belt decreased by ~ 20 times in comparison with 1964 because of disruption of the belt by artificially injected electrons from the Starfish high-altitude thermonuclear blast. (auth)

22394 EFFECT OF PRESSURE ANISOTROPY ON OSCILLATIONS OF MAGNETOTAIL. Ershkovich, A. I.; Mart'yanov, S. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 1, 71-78(1973).

Translated from Kosm. Issled.; 11: No. 1, 80-87(1973).

The Chew–Goldberger–Low (CGL) equations of quasihydrodynamics are applied to the study of the effect of pressure anisotropy on oscillations of the magnetotail. It is shown that the anisotropy of the pressure exerted by the solar-wind plasma can give rise to oscillations not present in the case of isotropy, while the anisotropy of the plasma pressure in the geomagnetic tail can bring about a substantial change in the pattern of existing oscillations, for instance the appearance of radial oscillations in the tail. (auth)

22395 OBSERVATION OF THE ENTRY OF SOLAR PROTONS INTO THE MAGNETOSPHERE AT VERY HIGH LATITUDES. Berthelier, J. J.; Pirre, M. (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, France). Compt. Rend., Ser. B; 276: No. 7, 279-282(12 Feb 1973). (In French).

During the initial phase of the absorption event following the solar eruption of the 28th of January 1967, it was possible to calculate at what distance from the Earth the protons precipitating in the polar caps had penetrated into the tail of the magnetosphere. These calculations were made using measurements made at the ground or low altitudes and also in interplanetary space. (FR)

22396 ELECTRIC FIELDS AND PLASMA CONVECTION IN THE PLASMASPHERE. Mozer, F. S. (Univ. of California, Berkeley). Rev. Geophys. Space Phys.; 11: No. 3, 755-765(Aug 1973).

A review is given of present theoretical and experimental information on quasistatic electric fields in and near the plasmasphere with the aim of discussing plasma flow within the plasmasphere, dynamo electric fields, and the penetration of electric fields of magnetospheric origin to low latitudes. Data are presented that suggest that the mean temporal variation of electric fields at all latitudes is diurnal, that dynamo electric fields are more important near L = 3 and are less important near and beyond L = 4 than are fields of magnetospheric origin, and that

magnetospheric fields with periods that are a reasonable fraction of one day efficiently penetrate the plasmapause. (auth)

22397 HIGH-ENERGY PROTON RADIATION BELT. White, R. S. (Univ. of California, Riverside). Rev. Geophys. Space Phys.; 11: No. 3, 595-632(Aug 1973).

The experiments and theories to explain the high-energy protons trapped in the Earth's radiation belt are reviewed. The theory of cosmic-ray albedo neutron decay injection of protons into the radiation belt is discussed. Radial diffusion and change in the Earth's dipole moment are considered along with losses of protons by ionization and nuclear collision. It is found that the measured albedo neutron escape current is sufficient to supply trapped protons above 30 MeV. The theoretical calculations of the trapped protons are in agreement with the measurements for $L \leq 1.7$ both on and off the equator. Although it appears that diffusion of solar-wind protons is responsible for most of the protons less than 30 MeV, additional measurements of the angular distributions and fluxes of low-energy neutrons are required to determine the contribution of the cosmic-ray albedo neutron decay source. For $L \geq 1.7$, additional trapped proton differential energy measurements should be made before the theory can be adequately tested. It appears that an additional loss mechanism such as pitch angle scattering may be required. (auth)

22398 LABORATORY STUDIES OF COLLISIONS OF ENERGETIC H^+ AND HYDROGEN WITH ATMOSPHERIC CONSTITUENTS. McNeal, R. J.; Birely, J. H. (Aerospace Corp., El Segundo, CA). Rev. Geophys. Space Phys.; 11: No. 3, 633-692 (Aug 1973).

Laboratory studies of ionization and excitation of atmospheric gases in collisions with 0.1- to 1000-keV protons and hydrogen atoms are reviewed. Recent measurements of the mixed flux of H^+ and H that penetrates the auroral zone atmosphere during a hydrogen aurora indicate that particles with energies less than 10 keV are most important, which implies that energetic hydrogen atoms cause most of the observed ionization and light emission. Both H^+ and H produce free electrons by collisional ionization of atmospheric constituents, and stripping of energetic H is an additional source of electrons. Reliable data are available for the cross section for production of electrons in collisions of H^+ and H with all important target gases, except atomic oxygen, over the full range of auroral energies. Excitation of atmospheric gases has been widely studied for H^+ collisions in the range above 10 keV, but cross sections for H^+ below 10 keV and H in any energy range are still largely unknown. Data are available for calculation of expected auroral emissions in the $v' = 0$ bands of the N_2^+ first negative system and in the $v' = 0$ bands of the N_2 second positive system. The ratio of the cross section for electron production by ionization to the cross section for emission of the 391.4-nm band of the N_2^+ first negative system is found to be about 20 for energies above 10 keV and then to rise to more than 100 at 1 keV. In the case of the hydrogen emissions, laboratory data are adequate for auroral calculations of Lyman α radiation. Collisional excitation of energetic H to the 2p level, rather than charge transfer excitation involving fast H^+, is the major source of Lyman α in the hydrogen aurora. Data on the production of the Balmer α line are lacking at energies below 10 keV. The available Balmer α data suggest a broad peak near 10 keV in the effective auroral cross section that is nearly an order of magnitude smaller than the peak in the Lyman α cross section, which occurs at energies less than or equal to 1 keV. Insufficient laboratory data exist for meaningful calculations of auroral Hβ intensities. (auth)

22399 LINEAR AND NONLINEAR STABILITY CHARACTERISTICS OF WHISTLERS. Brinca, A. L. Stanford, CA; Stanford Univ. (1973). 176p. University Microfilms Order No. 73-14,869.

Thesis (Ph. D.).

This work treats theoretically certain linear and nonlinear propagation characteristics of the right-hand polarized, slow electromagnetic, magnetoplasma waves known as "whistlers," and particularizes the results to conditions prevailing in the equatorial magnetosphere, i.e., to an effectively cold magnetoplasma permeated by a dilute nonthermal electron population with variable energy and pitch angle. The linear studies treat whistlers with wavenormals parallel and oblique to the static magnetic field. The nonlinear studies consist of theories of artificially stimulated emissions, and of the whistler modulation instability in cold and hot plasmas. (TSS)

22400 ORIGIN AND PROPAGATION OF CHORUS IN THE OUTER MAGNETOSPHERE. Burton, R. K. Los Angeles; Univ. of California (1973). 153p. University Microfilms Order No. 73-13,131.

Thesis (Ph. D.).

Wave normals of chorus in the outer magnetosphere have been determined for the first time from data obtained with the UCLA/JPL triaxial search coil magnetometer experiment on OGO-5, which provides complete vector information on the magnetic fluctuation vector between 1 and 1000 Hz. Wave normal distributions with respect to the geomagnetic field are presented for chorus detected outside of the plasmapause in two local time regions: (1) within four hours of local noon and, (2) within three hours of local midnight. The magnetic latitude of the measurements range from the equator to ±50° on the dayside and from the equator to 10° on the nightside. (TSS)

22401 NUCLEAR PHYSICS AND COSMIC RADIATION. The First 15 Years of the Institute of Pure and Applied Nuclear Physics, University of Kiel. Bagge, E. (Univ., Kiel). Atomkernenergie; 20: No. 3, 166-172(1972). (In German).

A report is given on the foundation, the development and the scientific activities of the institute. (GE)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 21425, 21427, 21928–21930, 21933, and 22012.

22402 (IPP-9/8) CHARACTERISTICS OF AN ION SOURCE FOR SURFACE RESEARCH IN THE ENERGY RANGE FROM 100 eV to 1.5 keV. Grundner, M.; Heiland, W.; Taglauer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Mar 1973. 33p. (In German). Dep. NTIS (U.S. Sales Only) $3.75.

An electron impact ion source for scattering rare gas ions (in the energy range 100 eV to 1.5 keV) from metal surfaces was investigated to determine the optimum operating conditions and efficiency. It was found that maximum ion extraction is only achieved under certain potential conditions. Furthermore, the value of the total ion current is influenced by the voltage drop at the cathode. At a pressure of about 5×10^{-4} torr in the source the ion current transmitted by the einzel lens attains values of 0.5 μA at 100 eV to 2 μA at 1 keV with maximum current densities of 0.40 $\mu A/cm^2$ to 42 $\mu A/cm^2$. The corresponding beam profiles show half-widths of 5.5 mm to 1.25 mm for a beam divergence from the target of approximately 1°. Energy analysis of the beam with a spherical capacitor yields a half-width of the energy distribution of 1%. At an electron acceleration voltage of 100 V the beam contains 12% doubly charged ions. This becomes less than 3% at an acceleration voltage of 50 V. In a backscattering experiment low-energy Ar^+ ions are fired at polycrystalline copper. This yields backscattered, sputtered or desorbed ions, depending on the degree of surface contamination. The energy distribution of these positive secondary ions is investigated at a scattering angle of 90°. With a clean target surface, Ar^+ ions (Ar^{2+} ions) in the energy range 300 eV to 1.5 keV are scattered by binary collisions. (auth)

22403 ION–ELECTRON EMISSION WITH COLORATION OF NaCl AND KBr CRYSTALS. Rakhimov, R. R.; Gaipov, S.; Abdulkhakov, I. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 9, 21-21(1972). (In Russian).

The bombardment of NaCl and KBr crystals with 20- to 1000-eV ions of Ne^- and Ar^- and the resulting ion–electron emission were studied. Measurements were made in a vacuum chamber at $\sim 2 \times 10^{-7}$ mm Hg. Coloration of the crystals definitely affected the ion–electron emission. At E_0 < 200 to 300 eV, the electron emission from colored NaCl crystals was reduced compared to pure NaCl; at E_0 > 200 to 300 eV, the reverse was true. These and similar phenomena are discussed relative to energies involved, type of ion, and electrons excited. (KSW)

22404 MODES OF OPERATION OF AN ELECTROSTATIC ION GUN. Rushton, G. J.; O'Shea, K. R.; Fitch, R. K. (Univ. of Aston, Birmingham, Eng.). J. Phys., D (London); 6: No. 10, 1167-1172 (29 Jun 1973).

An improved form of a new type of electrostatic ion gun, which is suitable for ion etching and ion thinning, is described. It is shown that the device has three main modes of operation, namely an oscillating mode, a transition mode and a general glow discharge mode. An explanation of these modes, together with the intensity and profile of the emerging ion beam obtained in each case, is given. It is suggested that advantage can be taken of these effects in specific applications. (auth)

22405 AMPLITUDE OF OSCILLATIONS OF THE POTENTIAL OF A QUASINEUTRAL ION BEAM. Zharinov, A. V. JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 366-368(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 508-511(5 May 1973).

The amplitude of the oscillations of the potential of a quasineutral ion beam is calculated approximately as a function of the dc and ac components of the ion-current density, the residual gas pressure, and the accelerating voltage. It is shown that at a limited potential amplitude the total ion-beam current does not depend on its height. (auth)

Atomic and Molecular Properties

Refer also to abstracts 20848, 22211, 22221, 22435, 22964, and 23968.

22406 (DNPL/R-26, pp 207-212) USE OF SYNCHROTRON RADIATION IN X-RAY PHOTOELECTRON SPECTROSCOPY. Fabian, D. J.; Fuggle, J.; Norris, P. R.; Watson, L. M. (Univ. of Strathclyde, Glasgow). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

It is stated that x-ray photoelectron spectroscopy (XPS), used for investigating the valence and conduction bands and inner core-levels of materials, provides information on electron densities of states, photoionization cross sections, electron binding energies, and chemical shifts in both valence and core-levels. The benefits to be expected from the use of synchrotron radiation are summarized. An outline is given of the basic features of a simple fixed wavelength monochromator under construction for preliminary studies at one selected wavelength in the synchrotron radiation continuum, and XPS measurements already made—without monochromation—with a standard x-ray anode using Al Kα-radiation are described. The results indicate the importance of ultra-high vacuum and the desirability of higher resolution. As an example, the spectra are shown of XPS valence bands measured for pure uranium metal, obtained after successively evaporating layers of "specpure" metal in high vacuum; ($\sim 4 \times 10^{-10}$ torr), and after exposure of the sample for several hours in lower vacuum, $\sim 2 \times 10^{-9}$ torr, showing the effect of surface contamination. It is stated that the VG-ESCA 3 photoelectron spectrometer, used for the experiments referred to above, using Al Kα-radiation, will be converted for use at the synchrotron facility with minimum modification. (UK)

22407 (FRNC-R-20, pp IV.23-IV.28) EQUIVALENCE OF BOHR-SOMMERFELD, KOSTANT–SOURIAU, AND PAULI QUANTISATION OF THE KEPLER PROBLEM. Simms, D. J. (Trinity Coll., Dublin). 1972.

It is shown that the existence of a Hilbert space representation of G, as exploited by Pauli in his treatment of the hydrogen atom, implies the Kostant–Souriau condition. This partially explains that the Bohr–Sommerfeld condition gives the correct energy levels for the hydrogen atom. (auth)

22408 (LBL-1666, p 248) TIME RESOLVED HANLE EFFECT IN THE $3^3P_{2,1,0}$ STATE OF ^4He. Yellin, J.; Hadeishi, T.; Michel, M. C. May 1973.

In nuclear chemistry annual report, 1972.

22409 (LBL-1666, pp 248-250) LIFETIME AND ALIGNMENT OF THE 5^1D_2 STATE OF ^4He BY BEAM–FOIL LEVEL CROSSING. Yellin, J.; Hadeishi, T.; Michel, M. C. May 1973.

In nuclear chemistry annual report, 1972.

22410 (LBL-1666, pp 250-252) ENERGY LEVELS OF Es I AND II. Conway, J. G.; Worden, E. F. May 1973.

In nuclear chemistry annual report, 1972.

22411 (LBL-1666, pp 355-357) IMPROVED RESOLUTION METHODS FOR BEAM–FOIL SPECTROSCOPY. Hadeishi, T.; Michel, M. C.; Yellin, J.; Geneux, E. May 1973.

In nuclear chemistry annual report, 1972.

22412 PHOTOIONIZATION CROSS SECTION FOR H_2 FROM THRESHOLD TO 30 eV. Kelly, H. P. (Univ. of Virginia, Charlottesville). Chem. Phys. Lett.; 20: No. 6, 547-550(15 Jul 1973).

The photoionization cross section of H_2 is calculated from threshold to 30 eV. The initial state is the self-consistent-field ground state of H_2 and the final states are the ground electronic state of H_2^+ and single-center continuum states calculated in the field of H_2^+. Exchange and screening effects are included. (auth)

22413 CALCULATION OF ELECTRONIC EXCITATION CROSS-SECTION FOR CESIUM ATOM. Brandus, L. (Inst. of Physics, Bucharest). Rev. Roum. Phys.; 18: No. 5, 681-684(1973).

The excitation cross section for the transition 6s–6p of the cesium atom in a modified Bethe approximation is calculated using Slater wave functions. (JFP)

22414 CALCULATION OF MAGNETO-OPTICAL ACTIVITY FOR RARE EARTH IONS IN SOLUTION. Livshits, M. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 6, 603-605(Dec 1972).

Translated from Opt. Spektrosk.; 33: No. 6, 1099-1104(Dec 1972).

A scheme is proposed for calculating the parameters of magnetooptical activity (MOA) for forbidden transitions in $4f^N$ configurations of trivalent rare earth ions. No more than three parameters selected from experiment permit a description of MOA for all transitions inside the $4f^N$ configuration. The magnetic circular dichroism spectrum of the Pr^{3+} ion is examined in particular. The observed spectrum is well described by the formulas obtained. (auth)

22415 IMPACT DEPOLARIZATION OF FLUORESCENCE OF ATOMS IN THE PRESENCE OF HYPERFINE STRUCTURE. 2.

Depolarization of Fluorescence of the $6^2D_{\frac{3}{2}}$ State of Thallium. Rebane, V. N.; Rebane, T. K.; Cherenkovskii, V. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 4, 337-341(Oct 1972).

Translated from Opt. Spektrosk.; 33: No. 4, 616-622(Oct 1972).

In connection with the construction of a model of the destruction of hyperfine coupling at the time of impact, the depolarization of fluorescence of the $6^2D_{\frac{3}{2}}$ state of the thallium atom upon collision with atoms of inert gases is calculated theoretically. The concept of the effective cross section for depolarization is generalized for the case of multiexponential relaxation. It is found that the breakup of the linear polarization of a broad line and of the majority of narrow lines is clearly multiexponential, and the corresponding cross sections depend strongly on pressure. In the case of circular polarization, the multiexponential character of relaxation is less pronounced, and the dependence of the effective cross sections for depolarization on pressure is weaker. The depolarization of the circular and linear polarizations of the broad line $6^2D_{\frac{3}{2}}-6^2P_{\frac{1}{2}}$ is measured. The theory agrees with the experiment within the limits of experimental error. (auth)

22416 KINETICS OF THE EXCITATION OF LEVELS OF THE HELIUM ATOM. Soldatov, A. N.; Evtushenko, G. S.; Murav'ev, I. I. (Physical-Technical Inst., Novosibirsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 46-54(1973). (In Russian).

An investigation was made of the mechanism of the excitation of the 2^3S_1, 2^1S_0, 2^3P_{012}, and 2^1P_1 levels of He in plasma discharge in hollow cathodes of specified construction. By use of the experimentally determined electron-kinetic characteristics, the populations of the levels indicated were calculated with consideration of the transitions between the levels. The calculated data agree with the results of optical measurements. (tr-auth)

22417 RELATIVE VALUES OF OSCILLATOR STRENGTHS FOR SPECTRAL LINES OF Gd I. Penkin, N. P.; Komarovsky, V. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 1-2 (Jan 1973).

Translated from Opt. Specktrosk.; 34: No. 1, 3-6(Jan 1973).

The relative oscillator strengths of 138 spectral absorption lines in Gd I were measured by Rozhdestvenskii's hook method. The lines were located in the 4800 to 3500 Å region and have the ground states a^9D^0, a^7D^0 and a $^{11}F^0$. A comparison was made between the theoretical and experimental intensities of spectral lines in the a^9D^0-y^9D, a^9D^0-z^9D and a^9D^0-y^9F multiplets of Gd I. The comparison showed that L-S coupling is absent in the gadolinium atom. (UDC 539.184) (auth)

22418 POLE SINGULARITY OF TRIANGULAR DIAGRAM. Gorshkov, V. G.; Sherman, S. G. (Inst. of Nuclear Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 374-377(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 519-522(5 May 1973).

The case is discussed when the singularities of one of the triangular-diagram vertices lies closer to the physical region than the singularities of the two other vertices. The energy levels of the hydrogen atom are considered. (JFP)

22419 INSTABILITY OF METALLIC HYDROGEN STRUCTURE TO SMALL CHANGES IN THE ALLOWANCE FOR THE ELECTRON–ELECTRON INTERACTION. Iordanskii, S. V.; Lokutsievskii, O. V.; Vul, E. B.; Sidorovich, L. A.; Finkel'shtein, A. M. JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 383-386(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 530-534(5 May 1973).

The binding energy of metallic hydrogen at zero pressure is calculated numerically in second and third order perturbation theory. It is shown that small changes in the allowance for the electron–electron interaction can lead to the vanishing of the metastable "metallic" minimum of the total energy. (auth)

22420 MEASUREMENT OF THE $3^2S_{\frac{1}{2}}-3^2D_{\frac{3}{2}}$ AND $3^2S_{\frac{1}{2}}-3^2D_{\frac{5}{2}}$ INTERVALS IN ATOMIC HYDROGEN. Glass-Maujean, M. (Univ., Paris). Opt. Commun.; 8: No. 3, 260-262(Jul 1973).

Stark mixing signals are used to measure the fine structure splittings S–D of n = 3 on H. The results are 4013.8 ± 0.8 MHz for the interval $3^2D_{\frac{3}{2}}-3^2S_{\frac{1}{2}}$ and 2929.9 ± 0.8 MHz for the interval $3^2D_{\frac{5}{2}}-3^2S_{\frac{1}{2}}$, both are in agreement with the theory. Taking into account the already known values for $3^2S_{\frac{1}{2}}-3^2P_{\frac{1}{2}}$ (experimental) and $3^2P_{\frac{3}{2}}-3^2P_{\frac{1}{2}}$ (theoretical), a value of (5.0 ± 0.9) MHz is deduced for the interval $3^2P_{\frac{1}{2}}-3^2D_{\frac{3}{2}}$. (auth)

22421 PHOTOIONIZATION OF THE 1^1S STATE OF HELIUM. Bell, K. L.; Kingston, A. E.; Taylor, I. R. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 7, 1228-1236(Jul 1973).

The continuous oscillator strengths for photoionization of the 1^1S state of helium are evaluated, in the dipole length and velocity formulations, for transitions which leave the He^+ ion in a 1s, 2s or 2p state. The calculations are performed with two sets of wave functions; calculation A uses frozen core Hartree-Fock bound and free state functions; calculation B uses a 56-parameter bound state representation with frozen core Hartree-Fock free state functions. Comparison with the results of Jacobs and Burke (J. Phys. B. Atom. Molec. Phys.; 5: L67-76 (1972)) indicates the energy ranges in which more accurate free state wave functions should be used. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

22422 REACTIONS OF CARBONIUM IONS WITH POSITRONIUM ATOMS IN SOLUTIONS. Bartal, L. J.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Phys. Chem.; 77: No. 17, 2060-2066(16 Aug 1973).

The reactions of Ps atoms with carbonium ions obtained by dissolving triphenylmethanol, pentaphenylcyclopentadienol, pentaphenylcyclopentadiene, or trichloromethylmesitylene in H_2SO_4 or CH_2Cl_2 saturated with BF_3 were studied and the rate constants measured. The results suggest that these carbonium ions are highly reactive toward Ps atoms and that their interaction may be diffusion controlled. The most likely type of interaction between these ions and Ps seems to be an electron transfer reaction leading to the corresponding organic radical and free positron. (auth)

22423 LIFETIME SPECTRA OF POSITRONS IN V_2O_3. Noguchi, M. (Japan Atomic Energy Research Inst., Tokyo); Kimizuka, N.; Chiba, T. J. Phys. Soc. Jap.; 34: No. 3, 661-665(Mar 1973).

Positron lifetime spectra in powdered $V_2O_{3.000}$, $V_2O_{3.02}$, and $V_2O_{3.03}$ were investigated from 122° to 300°K. Results are essentially in accord with those by Gainotti et al., and Greenberger et al. With a simple model, the following two tentative conclusions were drawn: One is a very low enhancement effect in a conduction band and the other is a small change in the electron-hole interaction through the insulator-metal transition. (auth)

22424 EXPERIMENTAL OBSERVATION OF ELECTRON PARAMAGNETISM OF MUONIC ATOMS. Varlamov, V. G.; Dobretsov, Yu. P.; Dolgoshein, B. A.; Kirillov-Ugryumov, V. G. (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 17: No. 4, 132-135(20 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 186-190(20 Feb 1973).

As established previously in noble gases with spinless nuclei there is no Larmor precession of the μ^--meson spin at the precession frequency of the free muon. It is shown that this is due to spin-orbit interaction of the muon with the electron shell of the muonic atom. (auth)

22425 K-MESIC ATOM. Myhrer, F. (Univ., Trondheim, Norway). Phys. Lett.; 45B: No. 2, 96-98(9 Jul 1973).

Assuming that the $Y_0^*(1405)$ resonance dominates the $\bar{K}N$ system at threshold, it is shown in a three-body $\bar{K}$-d model that to get the correct sign of the real part of the kaon-nucleus optical potential, one must use an off shell $\bar{K}N$ amplitude and that higher $\bar{K}N$ multiple scattering including intermediate nuclear excitations are important. (auth)

22426 SURFACE TENSION DEPENDENCE OF PICK-OFF ANNIHILATION RATE AND THE BUBBLE MODEL OF POSITRONIUM FORMATION. Levay, B.; Vertea, A. (Eoetvoes Univ., Budapest). Radiochem. Radioanal. Lett.; 14: No. 3, 227-234(30 Jun 1973).

Comparing the empirically found $\gamma^{\frac{1}{2}}$ dependence of pick-off annihilation rate in molecular liquids to the theoretically derived formulas of the bubble model some conclusions were drawn. A simple semiempirical method is suggested to estimate the depth of the potential well for the positronium atoms in molecular liquids. The depth of the potential well seems to be proportional to the number of valence electrons per unit volume. (auth)

22427 ROLE OF COHERENT RADIATION AND AN ACTIVE MEDIUM IN THE ANNIHILATION OF POSITRONS AND THE FORMATION OF EXCITED POSITRONIUM ATOMS. Gol'danskii, V. I.; Dalidchik, F. I.; Ivanov, G. K. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 1, 73-74(1973).

Translated from Khim. Vys. Energ.; 7: No. 1, 80-82(1973).

Estimates are given showing the possibility of the effective formation of excited positronium atoms in photo processes of the type $e^+ + e^-$ stimulated by external coherent radiation and also with the use of an optically active medium with an appreciable proportion of excited atoms. (JFP)

Collision Phenomena

Refer also to abstracts 22415 and 23154.

22428 (DNPL/R-26, pp 153-182) PHOTOIONIZATION AND PHOTOELECTRON SPECTROSCOPY OF METAL VAPOURS AND THEIR COMPOUNDS. Berkowitz, J. (Argonne National Lab., IL). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

The review covers the volatilities, calculated photoionization cross sections, and orbital and excitation energies. (JFP)

22429 (DNPL/R-26, pp 237-239) SIMULTANEOUS PHOTOIONIZATION-EXCITATION OF HELIUM: HIGH RESOLUTION OPTICAL MEASUREMENTS. Tracy, D. H.; Roesler, F. L. (Univ. of Wisconsin, Madison). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

Optical measurements are reported of cross sections for photoionization-excitation of helium. Helium gas at 77°K and pressures as low as 25 mtorr was irradiated through a 0.8 μm polypropylene film window by undispersed synchrotron radiation from the University of Wisconsin Physical Sciences Laboratory 255 MeV electron storage ring. Details of the method are given. The threshold 4686 Å fluorescence cross section was found to be $(2.3 \pm 0.7) \times 10^{-4}$ Mb, while the threshold 4 S photoionization-excitation cross section was $(3.2 \pm 1.3) \times 10^{-4}$ Mb. (UK)

22430 (DNPL/R-26, pp 247-250) MANY-BODY RESONANCE IN THE PHOTOABSORPTION CROSS SECTION FOR THE $4d^{10}$ SHELL IN Ba AND La. Wendin, G. (Centre Europeen de Calcul, Atomique et Moleculaire, Orsay, France). 1973.

From international symposium for synchrotron radiation users; Daresbury, England (4 Jan 1973).

Recent experiments show that the continuum photoabsorption cross section for the $4d^{10}$ shell in the rare-earth metals strongly peaks 15 to 20 eV above the Hartree–Fock $N_{IV,V}$ threshold, the width of the peak being 10 to 20 eV. It has been demonstrated that the corresponding broad peak (~35 eV) in atomic Xe can be interpreted in terms of a collective resonance involving coherent motion of all electrons in the $4d^{10}$ shell. Investigations are proceeding into the case of an isolated Ba and La atom in a similar way. The results obtained so far are discussed. (UK)

22431 (JINR-E4-7273) MULTIPLE SCATTERING WITHIN FINITE SYSTEMS OF GENERAL MUFFIN-TIN POTENTIALS. Ziesche, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

The concept of muffin-tin potentials is generalized. Potentials, being nonzero within an arbitrary volume, and their eigenstates are considered. The scattering states involve outside the enveloping sphere only asymptotic or far field properties described by generalized phase shifts and corresponding partial wave amplitudes. Clusters of such general muffin-tin potentials are considered. Into the equations, determining the cluster eigenstates, enter the cluster structure and the muffin-tin potentials separately only in the case of nonoverlapping spheres. Otherwise near field properties must be taken into account. Clusters of subclusters and clusters of potentials with finite sets of angular momenta are discussed as simple examples. The connection with generalizations of the KKR method is outlined. (auth)

22432 (UCID-16307) RECOMMENDED EXCITATION AND IONIZATION CROSS SECTIONS FOR CASCADE CALCULATIONS. Hiskes, J. R. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Jun 1973. Contract W-7405-Eng-48. 15p. Dep. NTIS $3.00.

A review is given, and cross sections are recommended for collisional excitation among excited levels and collisional excitation from the ground state respectively for hydrogen. In all cases reference is to statistical averages over sublevels. (JFP)

22433 DISPERSION INTERACTIONS BETWEEN UNEXCITED MOLECULES POSSESSING AXIAL SYMMETRY: ARBITRARY-ORDER CONTRIBUTIONS. van der Merwe, A. J. (Univ. of Denver). Found. Phys.; 3: No. 3, 297-311(Sep 1973).

The ground-state dispersion energy of a pair of axially symmetric molecules is calculated, to arbitrary order in the inverse intermolecular separation, on the basis of London's anisotropic oscillator model. (auth)

22434 v–v PUMPING IN H_2: ESTIMATE OF INDUCED DISSOCIATION AT 300°K. Jeffers, P. (SUNY, Cortland, NY); Hilden, D.; Bauer, S. H. Chem. Phys. Lett.; 20: No. 6, 525-527 (15 Jul 1973).

By means of the stimulated Raman effect one may produce in H_2, D_2, and in several other gases, a substantial population in the $v = 1$ state. Subsequent to the pulse excitation v–v energy transfers rapidly generate a vibrational distribution which is approximately equivalent to $(3-4) \times 10^3$°K. Then, in $H_2 + D_2$ mixtures metathetic reactions occur. A computer simulation of an experiment described elsewhere, designed to estimate whether a measurable fraction of the hydrogen molecules reach the upper vibrational level and dissociate is reported. Solutions of the coupled differential equations show that the anticipated hydrogen atom concentrations are too low by a factor of 10^7 to 10^8 to account for the observed H/D exchanges. These calculations also show that the conventional phenomenological rate equation for dissociation does not apply to this highly nonthermal distribution. (auth)

22435 EFFECT OF ATOMIC COLLISIONS ON THE POPULATION DISTRIBUTION OF HELIUM LEVELS. Pavlovskaya, E. N.; Podmoshenskii, I. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 9-11(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 19-23(Jan 1973).

It is shown that inelastic atomic collisions redistribute the populations of both singlet and triplet levels according to the temperature of the gas atoms. The effective intermixing cross sections are evaluated for a number of excited levels of helium. (UDC 539.186). (auth)

22436 IONIZATION ENERGY LOSSES OF HEAVY CHARGED PARTICLES. Yurkov, B. Ya. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 2, 239-241(1973). (In Russian).

An analysis of the work of F. Block showed that the original premises were essentially equivalents. This made it possible to deny the separation of the collision into two regions and to solve the problems directly. As a result from the sign of the logarithm a supplementary term appeared and a new expression for the mean ionization energy loss was derived. (JSR)

22437 PHOTOELECTRIC CROSS SECTIONS OF Al, Cu, Zr, Ag, Sn, Ta, AND Pb FOR 145 keV γ RAYS. Gowda, R.; Sanjeevaiah, B. (Univ. of Mysore, India). J. Phys., A (London); 6: No. 7, 1041-1045(Jul 1973).

Measurements of photoelectric cross sections of aluminum, copper, zirconium, silver, tin, tantalum, and lead for 145 keV γ rays were carried out using the well-type plastic scintillation spectrometer. The cross sections in these materials are found to be 0.261 ± 0.018, 10.32 ± 0.62, 37.82 ± 2.27, 79.83 ± 4.80, 98.97 ± 5.90, 430.9 ± 25.00, and 671.0 ± 40.00 b/atom respectively. These values are found to be in good agreement with the predicted values of Schmickley and Pratt (Phys. Rev.; 164: 104-116(1967)). (auth)

22438 MEASUREMENT OF THE CROSS SECTIONS OF SPIN EXCHANGE OF H ATOMS ($F = 1$, $m_F = 0$) ON PARAMAGNETIC O_2, NO, AND NO_2 MOLECULES IN THE TEMPERATURE INTERVAL 310 TO 390°K. Gordon, E. B.; Ivanov, B. I.; Perminov, A. P.; Ponomarev, A. N.; Tal'roze, V. L.; Khidirov, S. G. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 10, 395-397(20 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 10, 548-551(20 May 1973).

A hydrogen laser operating in the pulsed regime is used to measure the cross sections of spin exchange of H atoms in the hyperfine state ($F = 1$, $m_F = 0$) on the paramagnetic molecules O_2, NO, and NO_2. The cross sections are equal to 0.85×10^{-15} cm^2, 1.02×10^{-15} cm^2, and 0.88×10^{-15} cm^2, respectively. (auth)

22439 DEPENDENCE OF FAST-ION NEUTRALIZATION ON THE EMISSION ANGLE IN SCATTERING BY A METAL SURFACE. Luk'yanov, S. Yu.; Chicherov, V. M. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 10, 401-403(20 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 10, 560-563(20 May 1973).

The applicability of a simple model, in which the ion neutralization probability is determined by the time of its stay near the target surface or when the ion moves at an angle to the surface by the reciprocal of the normal component of its velocity, is verified for the neutralization of fast argon ions scattered by the atoms of the upper layers of a platinum target. The intensities of the ionic and neutral scattering components as functions of the emission angle and the intensity ratio as a function of the normal component of the velocity are shown for bombarding energies of 20 to 30 keV. (JFP)

22440 MEASUREMENTS OF CROSS SECTION FOR EXCITATION OF XENON LINES BY ELECTRON IMPACT. Rostovikova, G. S.; Samoilov, V. P.; Smirnov, Yu. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 3-5(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 7-12(Jan 1973).

The cross sections for the excitation of 36 Xe I lines, 58 Xe II lines, and 36 Xe III lines from the ground state of Xe I by single electron impact were studied. The measurements were done with a Hanle type electron beam. The 2200 to 6400 Å spectral region and electron energies from the excitation threshold to 400 eV were studied. The excitation functions were classified according to form. (UDC 539.186.2) (auth)

22441 EFFECT OF ROTATION ON VIBRATIONAL EXCITATION OF H_2 BY Li^+ IMPACT. Schaefer, J.; Lester, W. A., Jr.; (IBM Research Lab., San Jose, CA). Chem. Phys. Lett.; 20: No. 6, 575-580(15 Jul 1973).

Coupled channel calculations of integral cross sections for rotational and vibrational excitation of $H_2(X^1\Sigma_g^+)$ by collision with Li^+ are reported for 1.2 eV in the c.m. system employing an ab initio potential energy surface and numerical vibration–rotation functions of the Kołos–Wolniewicz potential function including adiabatic correction. Pure rotational excitation is found to strongly dominate the inelastic scattering occurring at this energy. Preparation of H_2 in various allowed nonzero rotational states is seen to enhance the $0 \rightarrow 1$ vibrational cross section by approximately an order of magnitude. (auth)

22442 USE OF CENTRAL-FIELD POTENTIALS FOR DESCRIBING $H_2(D_2)$ ELASTIC SCATTERING BY OTHER MOLECULES. Gordon, R. J.; Coggiola, M. J.; Kuppermann, A. (California Inst. of Tech., Pasadena). Chem. Phys. Lett.; 20: No. 6, 493-495(15 Jul 1973).

Differential elastic scattering cross sections were measured for the systems $H_2 + O_2$, SF_6, NH_3, CO, and CH_4 and for $D_2 + O_2$, SF_6, and NH_3 using crossed molecular beams. These experiments represent a wide variation in the size, anisotropy and initial relative collision energy E of the scattering partners, and of the corresponding de Broglie wave lengths. In all cases, rapid quantum oscillations were resolved. From these differential cross sections, central-field potentials were obtained which were independent of the energy and the isotopic composition of the hydrogen molecule used, as required for such potentials to be physically meaningful. Therefore, anisotropy effects do not seem important in describing the differential elastic scattering of these $H_2(D_2)$ systems. (auth)

22443 ELECTRON-LOSS CROSS SECTIONS OF LITHIUM ATOMS IN GASES. Pedersen, E. H.; Hvelplund, P. (Univ. of Aarhus, Denmark). J. Phys., B (London); 6: No. 7, 1277-1287 (Jul 1973).

Electron-loss cross sections σ_{01} for ground-state lithium atoms traversing hydrogen, helium, nitrogen, neon, argon, krypton, and xenon within the range of impact energies from 20 to 500 keV were measured by beam attenuation in a transverse electrostatic field. These experimental cross sections for loss of the loosely bound valence electron in neutral lithium are compared with theoretical estimates, based upon the semi-empirical classical impulse approximation of Bates and Walker (Planet. Space Sci.; 14: 1367-73 (1966). Further, the present cross sections for lithium atoms are compared with published experimental electron-loss cross sections for metastable hydrogen and helium atoms. On the basis of the theory mentioned above, similarities between these cross sections are expected. The overall agreement between the cross sections presented and the theoretical estimates, as well as the experimental electron-loss cross sections for metastable hydrogen and helium atoms is reasonable. A more detailed comparison is, however, made difficult by the fact that results from different laboratories in some cases show poor agreement. (auth)

22444 FORMATION OF H(2s) AND H(2p) IN COLLISIONS OF ATOMIC HYDROGEN WITH ATOMIC HELIUM. Bell, K. L.; Kingston, A. E.; McIlveen, W. A. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 7, 1246-1254(Jul 1973).

The first Born approximation is used to calculate total cross sections for excitation of the 2s and 2p states of hydrogen by collision with helium. Full account is taken of double excitation processes and the calculations are performed using both length and velocity formulation values of the helium matrix elements. An impact parameter close coupling treatment of the particular process in which the helium atom remains unexcited is carried out with the inclusion of pseudo excited hydrogenic states. The first Born approximation values are in good accord with experiment for energies greater than 10 and 30 keV for 2s and 2p excitation, respectively, and, for the latter case, are in excellent agreement with experiment in the region 40 to 120 keV where the cross section is almost constant due to the interplay of nonexcitation and excitation of the target. At low impact energies, the pseudo-state calculation is an improvement upon previous 4-state calculations but still fails to agree both in shape and in magnitude with experimental data. (auth)

22445 CALCULATION OF RESONANCES IN ELECTRON-ION SCATTERING USING THE DISTORTED WAVE APPROXIMATION. Hershkowitz, W. D.; Seaton, M. J. (Univ. Coll., London). J. Phys., B (London); 6: No. 7, 1176-1187(Jul 1973).

In the distorted wave approximation, radial functions F_l for the colliding electron are calculated using a central potential $V_l(r)$. The Kohn variational method is then used to calculate the R matrix; this is the matrix, used in quantum defect theory, which varies slowly as a function of the energy. For closed channels the functions F_l are calculated at the eigen-energies for the central-potential problem, and suitably normalized. The resonance structures are calculated using methods of quantum defect theory. Illustrative results are obtained for the $2s^2\ ^1S$-$2s2p\ ^3P$ transition in C III and in O V, and compared with results obtained from exact solutions of coupled integro-differential equations. It is concluded that, for the calculation of rate coefficients for the excitation of more highly ionized positive ions: it is necessary to take resonances into account and; good results can be obtained using the distorted wave method. (auth)

22446 IONIZATION PROCESSES IN He–He COLLISIONS. Barat, M.; Dhuicq, D.; Francois, R.; Lesech, C.; McCarroll, R. (Paris Univ., Orsay, France). J. Phys., B (London); 6: No. 7, 1206-1217(Jul 1973).

Differential scattering measurements of ionization in He–He collisions are made in the keV energy range using the energy loss technique. Combining the results with those obtained from the ejected electron spectra measurements of Gerber (J. Phys. B. Atom. Molec. Phys.; 6: 493-510 (1973)), the ionization process is discussed in the framework of the quasimolecular picture of the collision. Two-step mechanisms are proposed involving a primary radial or rotational coupling either to a molecular state which autoionizes during the collision or to a state which leads on dissociation to the formation of He^- in an autoionizing state. Calculations taking account of rotational coupling effects between the $^1\Sigma_g$, $^1\Pi_g$, and $^1\Delta_g$ states of He_2 are in satisfactory agreement with experiment for energy E and scattering angle θ when $E\theta$ exceeds 3 keV deg. (auth)

22447 ONE CENTRE MOLECULAR STUDY OF THE SINGLE IONIZATION OF He BY He^+ IMPACT AT MODERATE ENERGY. Sidis, V. (Centre de Mecanique Ondulatoire Appliquee, Paris). J. Phys., B (London); 6: No. 7, 1188-1205(Jul 1973).

A theoretical study is reported on the single direct ionization of He by He^+ impact at moderate energies. Following Barat et al (J. Phys. B. Atom. Molec. Phys.; 5: 1343-50 (1972)) this process is considered as arising from a molecular autoionization of the $(1s\sigma_g 2p\sigma_u^2)^2\Sigma_g^+$ diabatic state of He_2^+ as it crosses the boundary of the continuum ($He_2^{++} + e^-$). First the molecular orbitals involved in the problem are expanded in terms of Slater type orbitals centered at the midpoint of the internuclear distance of He_2^+. The resulting wave functions together with a Coulomb description of the ejected electron lead to an expression of the autoionization width as sums over hypergeometric functions ${}_2F_1$. This width is subsequently involved in the coupled equations for the nuclear motion which are solved in a distorted wave-(WKB)-semi-classical approximation. The computed oscillatory energy distribution of the ejected electrons is in satisfactory agreement with the experimental results of Barat et al. (auth)

22448 EXCITATION OF HELIUM IN He^+–He AND He–He COLLISIONS: THE INFLUENCE OF METASTABLE HELIUM IONS. Blair, W. G. F.; McCullough, R. W.; Simpson, F. R.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 7, 1265-1276(Jul 1973).

The excitation of helium by 20 to 100 keV He^+ and He beams was investigated by the spectroscopic analysis of radiation emitted in the spectral range 3900 to 6000 Å during the spontaneous decay of the excited products of single collisions. Observations were made at 54.5 deg with respect to the primary beam to permit a Doppler shift separation of target and projectile emissions. Absolute cross sections for the excitation of 4^1S, 4^1D, 4^3S, and 4^3D levels were determined. Cross sections for excitation by He^+ and He impact were compared with a relative accuracy of ±12%. Measurements were also carried out with He beams containing different known fractions of metastable atoms. These data were used to determine approximate cross sections at 70 keV for the processes: $He(2^3S) + He \rightarrow He(4^3S \text{ or } 4^3D) + He$ and $He(2^3S) + He \rightarrow He + He(4^3S \text{ or } 4^3D)$. (auth)

22449 DESTRUCTION OF FAST METASTABLE HYDROGEN ATOMS PASSING THROUGH ATOMIC HELIUM. Bell, K. L.; Kingston, A. E.; McIlveen, W. A. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 7, 1237-1245(Jul 1973).

The first Born approximation is used to calculate cross sections for excitation or de-excitation to discrete states from fast metastable hydrogen atoms passing through atomic helium. Full

account is taken of double transitions and the calculations are performed using length and velocity formulation values of the Born helium matrix elements. Close coupling values in the impact parameter theory for the specific transitions 2s to nl(nl = 1s,2p,3s, 3p) in hydrogen with the target helium atom unexcited indicate that coupling to excited states and to the hydrogen continuum is not important for these particular destruction processes for impact energies greater than 10 keV. Addition of the present Born approximation results to those of Bell and Kingston (J. Phys. B. Atom. Molec. Phys.; 4: 162-7 (1971)) for the electron loss contribution provide total destruction cross sections which are a factor of about 2.5 lower than the experimental data (5 to 30 keV) of Gilbody et al (J. Phys. B. Atom. Molec. Phys.; 4: 94-110 (1971)). For electron loss, the recent data of Hughes and Choe (Phys. Rev.; A6: 746-55 (1972)) suggests that the first Born approximation may be satisfactory for impact energies greater than 100 keV. (auth)

22450 Ar^+–Ar MOMENTUM TRANSFER CROSS SECTIONS IN THE RANGE 4 TO 7 eV. Frommelt, J. J. B.; Jones, I. R. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 6: No. 7, L178-L181(Jul 1973).

The experimental technique of measuring cross sections for momentum transfer between ions and atoms by observing hydromagnetic waves is greatly simplified if standing rather than propagating waves are used. Measurements are reported of Ar^+–Ar momentum transfer cross sections in the energy range 4 to 7 eV using standing magnetoacoustic waves. (auth)

22451 DIFFICULTIES WITH THE FADDEEV–WATSON MULTIPLE SCATTERING EXPANSION IN ATOMIC PHYSICS. Byron, F. W.; Joachain, C. J. (Univ. of Massachusetts, Amherst). J. Phys., B (London); 6: No. 7, L169-L170(Jul 1973).

A major discrepancy is pointed out between the Faddeev–Watson multiple scattering expansion and the Born multiple scattering expansion for the elastic scattering of electrons and positrons by atomic hydrogen and give arguments in favor of the Born approach. (auth)

22452 ANOMALY IN THE CROSS SECTIONS FOR ELECTRON LOSS AND CAPTURE BY MULTIPLY CHARGED IONS IN NEON. Volodyagin, Yu. S.; Dmitriev, I. S.; Nikolaev, V. S.; Tashaev, Yu. A.; Teplova, Ya. A. (Moscow State Univ.). J. Phys., B (London); 6: No. 7, L171-L173(Jul 1973).

The electron loss and capture cross sections for multiply charged He, N, Ne, and Ar ions at velocities V from 3×10^8 to 10^9 cm s^{-1} in helium, nitrogen, neon, and argon were measured. It was found that due to a higher average velocity of outer electrons in Ne atoms the dependences of these cross sections on nuclear charge of target atoms at V ~ 10^9 cm s^{-1} become nonmonotonic: the values $\sigma_{i,i+1}$ in neon become smaller and $\sigma_{i,i-1}$ greater than in nitrogen and argon. (auth)

22453 ANALYSIS OF UNRESOLVED INELASTIC ENERGY LOSS SPECTRA IN ION–ATOM COLLISIONS. Garcia, J. D.; Fortner, R. J. (Univ. of Arizona, Tucson). J. Phys., B (London); 6: No. 7, L174-L177(Jul 1973).

A method for determining the number of inner shell vacancies associated with unresolved inelastic energy loss spectra is discussed. This consists of using atomic total energy calculations together with the data on total ionization to reproduce the energy losses observed in scattering experiments. The method is applied to existing data for Ar–Ar collisions at various energies. Several features in the data can be interpreted in terms of a molecular orbital model for the collison. (auth)

22454 IMPORTANCE OF ELECTRONIC CORRELATIONS FOR THE CALCULATION OF X RAY AND FAST ELECTRON SCATTERING BY Be, B, C, N, O, F. 2. Naon, M.; Cornille, M. (Centre de Mecanique Ondulatoire Appliquee, Paris). J. Phys., B (London); 6: No. 7, 1347-1356(Jul 1973).

During the last two or three years many people have studied the importance of electronic correlations for the scattering of x rays and fast electrons by atoms. The increments to the mean values of the operators which appear in the scattering phenomena were calculated using the atomic Bethe Goldstone equations which give the total correlation energies range from 98.5 to 100.3% of the empirical correlation energy. The results are compared with those obtained previously. It is concluded that it is necessary to take account of the electron correlations for comparison between theory and experiment. (auth)

22455 MODIFIED CORRESPONDENCE PRINCIPLE FOR STRONGLY COUPLED STATES. Clark, A. P. (Univ. of Stirling, Eng.). J. Phys., B (London); 6: No. 7, 1153-1164(Jul 1973).

The one-dimensional form of the correspondence principle for strongly coupled states of Percival and Richards (J. Phys. B. Atom. Molec. Phys.; 3: 1267-71 (1970)) is modified to include, approximately, the perturbation of the bound particle orbit. The modification will only be significant when the expectation value of the interaction potential depends on the state of the bound system. The excitation of a linear harmonic oscillator by a time dependent potential $q^2F(t)$ and the collinear collision of an atom and an anharmonic diatomic molecule are considered as examples. The results obtained for both these systems are in good agreement with the exact quantum mechanical transition probabilities, even for low order transitions. (auth)

22456 SIMULTANEOUS MULTIPHOTON IONIZATION AND EXCITATION OF HELIUM IN AN INTENSE LASER BEAM. Mohan, M. (Univ. of Delhi). J. Phys., B (London); 6: No. 7, 1218-1227(Jul 1973).

The transition amplitude corresponding to multiphoton absorption resulting in simultaneous ionization and excitation of the helium atom in the presence of an intense laser beam was evaluated by using the recent method of Reiss (Phys. Rev.; A1 803-18 (1970) and Phys. Rev. Lett.; 22: 693 (1970)). Results show that reduced transition amplitude varies linearly with initial value of the intensity but for high intensity the slope of the curve decreases, showing an important nonlinear effect. It is found that as the intensity increases the maximum number of photons taking part in the process also increases. Another important feature found is the dominance of the multiphoton ionization process over the multiphoton excitation process at high intensities. (auth)

22457 THEORETICAL STUDY OF PROTON–HELIUM SCATTERING. Baye, D.; Heenen, P. H. (Univ., Brussels). J. Phys., B (London); 6: No. 7, 1255-1264(Jul 1973).

The second order diagonalization method is used to study proton-helium scattering. The results are compared for 1^1S-2^1S and 1^1S-2^1P cross sections with various other theoretical calculations and with the experiment of Park and Schowengerdt (Phys. Rev.; 185: 152-64 (1969)). For higher levels, the values are compared with experiments. A very good agreement is found for n^1S and n^1P states (n = 5). The discordance for the n^1D states is discussed. Polarizations of n^1P-2^1S, n^1D-2^1P and 4^1F-3^1D lines are also presented. (auth)

22458 CLASSICAL FREE-FALL ATOMIC MODEL. Bates, D. R.; Snyder, R. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 7, L159-160(Jul 1973).

Gryzinski's free-fall atomic model (Phys. Rev. Lett.; 14: 1059 (1965) and Phys. Lett.; 41A: 69-70 (1972)) is tested by being used in classical calculations on electron capture in fast collisions between protons and hydrogen atoms. It is found to be unsatisfactory. (auth)

22459 CAPTURE AMPLITUDE FOR THE IONIZATION OF He BY ELECTRON IMPACT. Phillips, D. H.; McDowell, M. R. C. (Royal Holloway Coll., Englefield, Eng.). J. Phys., B (London); 6: No. 7, L165-L168(Jul 1973).

It is shown that the capture process is unimportant in ionizing collisions of electrons with helium atoms, in the range of validity of Born's approximation, except in predictions of the triple differential cross section in regions of energy and angle where the exchange contribution is small. (auth)

Atomic Theory

22460 SPIN PROJECTED EXTENDED HARTREE–FOCK EQUATIONS. Mayer, I.; Ladik, J.; Biczo, G. (Central Research Inst. for Chemistry, Budapest). Int. J. Quant. Chem.; 7: No. 3, 583-608(May 1973).

The (spin projected) extended Hartree–Fock equations are derived and discussed in the general ("many λ_i") case. The derivation is based on the corresponding generalized Brillouin theorem, substituting in its expression the spin projected DODS Slater determinant as a linear combination of determinants. The expressions obtained for the elements of the different matrices ϵ^{cd} (c = a or b, and d = a or b) occurring in the equations are analyzed. The transformation of the equations into the form of a pseudoeigenvalue problem and the LCAO form of the equations are given, too. Finally the relation to the Goddard's GF equations is discussed in detail. (auth)

22461 COUPLED HARTREE–FOCK CALCULATION OF THE UNIFORM FIELD QUADRUPOLE POLARIZABILITIES AND SHIELDING FACTORS OF S-STATE IONS. Bhattacharya, A. K.; Mukherjee, P. K. (Saha Inst. of Nuclear Physics, Calcutta). Int. J. Quant. Chem.; 7: No. 3, 491-499(May 1973).

Uniform field quadrupole polarizabilities and shielding factors of the first three ions of 2-, 3-, and 4-electron sequences in their ground states were calculated in the coupled Hartree–Fock (CHF) scheme. For comparison the uncoupled Hartree–Fock (UHF) results are also presented. It is observed that the uniform field quadrupole polarizabilities differ slightly in the two schemes and

agree well with the UHF results of Lyons, Langhoff, and Hurst. However the shielding factors differ appreciably in the two schemes and are completely different from those of Lyons et al. The cause of the difference in the shielding factor values is investigated. (auth)

22462 DEVELOPMENTS IN THE SPIN-EXTENDED HARTREE–FOCK METHOD. Mestechkin, M. M. (Donetsk Dept. of Physical Chemistry Inst., USSR). Int. J. Quant. Chem.; 7: No. 3, 425-457(May 1973).

All the second-order density matrix spin components for the spin-extended Hartree–Fock method are obtained. The coefficients in the final formulas are only ω_{sM}, $\omega_{sM\pm1}$, $\omega_{sM\pm2}$, where ω_{sM} are the weights of pure states of spin s in the initial unprojected determinant with spin projection M. The eigenvalue problem for the best electron density natural orbitals in the spin-extended method is formulated. All the second-order transition density matrix spin components between pure spin basis functions built of orthogonal orbitals and distinguished by different core choice are also found. This basis may be used on CI calculations. (auth)

22463 ACCELERATION OF ATOMS BY A STATIONARY FIELD. Kazantsev, A. P. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 4, 150-153 (20 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 212-215(20 Feb 1973).

A special resonant-field configuration in which the atom is acted upon by a spatially constant field is considered. The excited atom can be accelerated in this case to an energy of 1 keV. This effect can be used for spatial separation of excited and nonexcited atoms in an atomic beam. (auth)

22464 PERTURBATION THEORY FOR THE HARTREE–FOCK EQUATION. Ivanova, E. P.; Safronova, U. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 4, 329-337(Oct 1972).

Translated from Opt. Spektrosk.; 33: No. 4, 601-606(Oct 1972).

Perturbation theory for interelectron interactions was used for studying the Hartree–Fock equation. The Hartree–Fock energy was expanded in a power series of $Z[E^{HF} = E_0Z^2 + \Delta E_1^{HF} Z + \Delta E_2^{HF} + (1/Z)\Delta E_3^{HF}]$. For ΔE_1^{HF}, ΔE_2^{HF}, and ΔE_3^{HF} an analytic expression was obtained for states with filled and unfilled shells. Numerical results for ΔE_1^{HF}, ΔE_2^{HF}, and ΔE_3^{HF} were obtained for the ground states of light atoms. (auth)

22465 DIFFICULTIES INHERENT IN SACHS'S NEW THEORY OF ELEMENTARY MATTER. Leiter, D. (Windsor Univ., Ont.). Int. J. Theor. Phys.; 7: No. 3, 199-203(Apr 1973).

It is shown that the atomic energy levels, predicted by a recently proposed new theory of elementary matter, are in one-to-one correspondence with the relativistic Hartree self-consistent field theory for atomic structure. This means that this theory will contain solutions which violate the Pauli exclusion principle, as well as neglect the important effects of configuration interaction in atomic structure. This would tend to cast doubt on the viability of the new theory in its present form. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 23980.

22466 ELECTRODYNAMIC VISCO-PLASTIC FLUID FLOW. Makarov, A. M.; Martinson, L. K.; Romanovskii, V. R.; Simkhovich, S. L. Magn. Gidrodin.; No. 1, 56-60(1973). (In Russian).

Stationary electrodynamic Schwedov–Bingham plastic flow was examined in a flat channel with dielectric walls in a longitudinal homogeneous electric field under the influence of time-constant pressure gradients. Different regimes of the medium flow were investigated. The distributions of the tangential stress of the displacement and the velocity of the medium were obtained in dependence on the electric and rheological parameters. (tr-auth)

22467 THEORY OF MAGNETIC FLUIDS. Jenkins, J. T. Arch. Ration. Mech. Anal.; 46: No. 1, 42-60(1972).

The balance equations for a fluid under a magnetic field are formulated by including terms due to the magnetic stress tensor and the magnetic energy. Constitutive equations are derived for paramagnetic and ferromagnetic fluids. For the latter, the constitutive functions depend on the gradient of the magnetization vector. The thermodynamic entropy inequality provides a series of restrictions of the constitutive functions. Special functions for incompressible paramagnetic fluids are suggested, and one method for the experimental determination of the magnetic energy term is described. (App. Mech. Rev.)

22468 FLOW PROCESS OF NON-NEWTONIAN FLUIDS UNDER THE INFLUENCE OF MAGNETIC AND ALSO ELECTRIC FIELDS. Schroeder, P. Ing.-Arch.; 41: No. 3, 141-156(1972). (In German).

An analytical approach is used to examine the influence of magnetic and electric fields on the laminar flow of non-Newtonian fluids. For dilatant fluids the existence of a limit Hartmann number is emphasized; when the Hartmann number is greater than this limit value, a simple solution of the equation of motion is given in terms of shear stress instead of the usual solution in terms of velocity. It is to be noted that for dilatant fluids a layer may exist in which the fluid is at rest or may behave as a rigid body (a sort of Bingham-plastic flow). The thickness of that layer depends on electric field and on head loss; it first grows with increasing electric field and head loss, then decreases and vanishes. The characteristics of motion in presence of head loss and electric field may be achieved from known solutions without head loss or electric field. Graphs for magnetic field strength, velocity, density of electric current, and shear stress are given for fluids obeying the rheological power law or the law of Prandtl; for the last ones a closed analytical solution is also given. (App. Mech. Rev.)

22469 HYDROMAGNETIC FLOW OF AN ELECTRICALLY CONDUCTING FLUID DUE TO UNSTEADY ROTATION OF A POROUS DISK OVER A FIXED DISK. Khan, M. A. A. (Lucknow Univ., India). Indian J. Pure Appl. Math.; 3: No. 4, 556-567 (Jul 1972).

The unsteady hydromagnetic flow of a viscous, incompressible and electrically conducting fluid due to rotary vibrations of a porous disk about a constant nonzero mean over a fixed disk has been analyzed. The fixed disk is supposed to be nonporous and the angular velocity of the other disk which is porous is assumed to consist of basic steady distribution together with a time varying distribution. (auth)

22470 EFFECT OF THE MAGNETIC FIELD ON THE TURBULENT SHEAR FLOW. Abramovich, G. N.; Kovner, D. S.; Kolpakov, A. Ya.; Dushchik, V. G. Magn. Gidrodin.; No. 1, 19-25(1973). (In Russian).

By means of a modification of the Prandtl formula, taking into account the effect of differently oriented magnetic fields on the flow, analytical and numerical solutions were obtained on problems of turbulent flow in the vicinity of the rigid walls in tubes of flat and circular cross section and also in jet displacement layers. A comparison of the results of the calculations with the experimental results made it possible to select the value of the empirical constants characterizing the effect of the magnetic field on the turbulence. The use of single constants for all forms of the flow brought the experimental and calculated data to satisfactory agreement. For the flow in tubes in a longitudinal magnetic field and in field, perpendicular to the flow plane, it is possible to use data of tests in critical regime for satisfactory agreement of the results. (tr-auth)

22471 UNSTEADY FLOW OF A CONDUCTING VISCOUS FLUID BETWEEN PARALLEL PLANES WITH HEAT TRANSFER. Sharikadze, D. V.; Megakhed, A. A. Magn. Gidrodin.; No. 4, 25-30(1972). (In Russian).

The unsteady flow of a viscous incompressible electroconducting fluid between two parallel permeable nonconducting moving planes was examined with consideration of heat transfer when a homogeneous external magnetic field is applied perpendicularly to the plane. In the heat transfer equations both the viscous dissipation and the Joule effect were taken into account. In the basic equations of magnetohydrodynamics, the transverse velocity of the flow was replaced by the velocity of permeability $v_0(t)$ and the system of equations obtained was reduced to the resolution of the Volterra integral equation. In the presence of Prandtl magnetic numbers, even units, solutions were obtained in an explicit form, expressed by tabular functions. (tr-auth)

22472 UNSTEADY VISCO-PLASTIC FLUID MHD FLOW IN PLANE CHANNELS. Makarov, A. M.; Pavlov, K. B.; Sal'nikov, V. G. Magn. Gidrodin.; No. 4, 31-34(1972). (In Russian).

A problem was examined on the unsteady MHD flow of conducting visco-plastic medium in plane channels under the influence of time-variable stress gradients and with arbitrary movement of the wall of the channel. By the method of prolongation of the initial conditions, a system of functional equations was obtained. It was shown that for a given class of movement of the viscoplastic medium the resolution of the system of functional equations can be put in the form of a power series. (tr-auth)

22473 UNSTEADY MHD FLOWS OF VISCO-PLASTIC FLUIDS IN PLANE CHANNELS. Pavlov, K. B. Magn. Gidrodin.; No. 4, 35-40(1972). (In Russian).

The unsteady flow of a conducting visco-plastic medium in a transverse magnetic field was examined in the noninduction approximation. A solution was constructed which describes the irregular flow with moving boundaries, dividing zones of quasi-solid and viscous flow. Singularities of the development of plane MHD flow of the Couette type were noted. (tr-auth)

22474 UNSTEADY MOTION OF A VISCO-PLASTIC MEDIUM IN A FLAT MHD DUCT AT A CONSTANT VOLUMETRIC FLOW. Kosachevskaya, E. A.; Kosachevskii, L. Ya. Magn. Gidrodin.; No. 4, 41-46(1972). (In Russian).

The motion of a conducting Shvedov–Bingam plastic under the influence of motion gradients in an MHD channel of rectangular cross section was examined. It was assumed that the installation, the moving plastic, can maintain its consumption Q, invariably during time-variable motion gradients P(t). Two walls of the channel, perpendicular to the external magnetic field B, are nonconducting and two others, good conducting electrodes, are closed to the active resistance r_e. By the characteristic singularities of the moving plastic, the presence of a quasi-solid zone appears. The dimension of this zone during unsteady motion changes with time. (tr-auth)

22475 HARTMANN TURBULENT FLOW. Ber, L. E. Magn. Gidrodin.; No. 4, 47-52(1972). (In Russian).

On the basis of differential equations of steady-state isothermal mean turbulent motion of incompressible electroconducting fluids in magnetic fields, the problem of Hartmann turbulent flow was resolved. The integral method was assumed for the resolution. The dependences, expressed by the theorem on the quantity of motion and the kinetic energy in the integral form, and the integral formula, generalizing this theorem, were examined. The resolution for velocity was in the form of three-parametric set of curves. By means of the substitution of this set of curves in the integral formula, three unknown parameters of the resolution sought can be obtained. The resolution obtained for the velocity and also the formulas derived for the coefficient of resistance and the Reynold's number were applied to laminar and turbulent regimes of motion in nonmagnetic and magnetic cases. (tr-auth)

22476 SEMI-EMPIRICAL ESTIMATE OF A TURBULENT MHD FLOW ANISOTROPY IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD. Gurfink, M. M. Magn. Gidrodin.; No. 4, 53-56(1972). (In Russian).

A semi-empirical theory was proposed in which attempts were made to evaluate the anisotropy of an MHD turbulence during flow in a tube in a longitudinal magnetic field. The basic hypotheses were based on the assignment of bonds between the relationship of the turbulent flow to the energy and the relationship of the turbulence flow to the energy and the relationship of the turbulence scaling ratios and also expressions for the relationship of scaling ratios through the magnetic field. Qualitative and quantitative agreement was obtained with recent experimental data. The quantitative effect was predicted which consists of the increase of the dependence of the coefficient of resistance on Re (where Na/Re = constant) at $Re > 10^5$. This was shown by the increase of the longitudinal scaling ratio of the turbulence. (tr-auth)

22477 CONVECTIVE INSTABILITY OF A CONDUCTING FLUID IN THE PRESENCE OF A MAGNETIC FIELD. Brickman, V. A. Magn. Gidrodin.; No. 4, 57-61(1972). (In Russian).

The effect of a homogeneous alternating magnetic field on the convective instability on the plane layer of an electroconducting fluid was investigated. The frequency of the alternation of the transverse magnetic field is considered small so that the skin effect is unimportant. The smallness of the amplitude of the alternating field was assumed. The equations of disturbed equilibrium of the fluid are reduced to a system of three linear ordinary differential equations of the first order with nonperiodic coefficients. It was shown that there is a range value of the characteristic parameters in which the alternating field stabilizes the Rayleigh instability – analogous to that occurring in a constant field. At a sufficiently large Lundquist number in the alternating field a new resonance type of instability appears. For different values of the ratio of the Batchelor and Prandtl numbers the dependences of the critical values of the Rayleigh and Lundquist numbers on the dimensionless frequencies of the oscillation of the field were constructed. The form of the neutral curve is characterized by the parametric excitation of the instability. (tr-auth)

22478 ESTIMATION OF THE EDGE EFFECT IN A MULTICHANNEL MHD DEVICE. Grinberg, G.; Zanders, Yu. Magn. Gidrodin.; No. 4, 102-106(1972). (In Russian).

The edge effect in a multichannel conduction device, designed for the investigation of the MHD process in the range of average R_m, was evaluated. The evaluation was done by means of the substitution of the real current by a strengthened current system. The currents were calculated by an equivalent scheme of the device. The model investigated occurs only at $R_m \ll 1$ and appears with the first approximation for subsequent calculations. The expediency of the use of the charged Cu for decrease of the edge effect of the device was established. (tr-auth)

22479 INTERACTION BETWEEN THE MAGNETIC FIELD AND THE TURBULENT CONDUCTING FLUID. Pleshanov, A. S.; Tseskis, A. L. Magn. Gidrodin.; No. 1, 135-137(1973). (In Russian).

For small values of the Lorentz force by means of the turbulence theory it was shown that if the work of the Lorentz force is positive, then the turbulence is suppressed by a magnetic field. In the opposite case increase of the intensity and number of the degrees of freedom of the turbulent motion occurs. (tr-auth)

22480 TWO-DIMENSIONAL TURBULENCE IN A MAGNETIC FIELD. Pleshanov, A. S.; Tseskis, A. L. Magn. Gidrodin.; No. 1, 137-139(1973). (In Russian).

In the approximation of small Reynolds magnetic numbers it was shown that in a sufficiently strong magnetic field the turbulent motion of the conducting fluid becomes two-dimensional. Some anomalous properties of such turbulence were considered and questions on the final period of its degeneration in the magnetic field were examined. (tr-auth)

22481 FLOW VELOCITY STRUCTURE IN A MAGNETIC FIELD CHANGING PERIODICALLY ALONG THE FLOW. Gel'fgat, Yu. M.; Peterson, D. E.; Tsinober, A. B. Magn. Gidrodin.; No. 1, 139-141(1973). (In Russian).

A numerical calculation was made of the MHD flow in a magnetic field changing periodically along the flow. The M-shaped flow velocity structure was obtained, confirming the storage of the effect of deformation of the velocity profile during passage with the current of a series of in-series amplitudes of the field. It was shown that nevertheless in the presence of M-shaped velocity structures, the lines of the fluid flow are practically rectilinear. (tr-auth)

22482 EFFECT OF CROSSED ELECTRIC AND MAGNETIC FIELDS ON LIQUID METAL DROP OSCILLATIONS. Dobychin, E. I. Magn. Gidrodin.; No. 1, 142-145(1973). (In Russian).

The results of the experimental investigation of the oscillations of liquid metal drops in crossed electric and magnetic fields were reported. The oscillations of the drops were assigned with sudden transitions to weightlessness. The data on the character of the effect of the crossed fields on the oscillations of the drops were reduced to the form of the dependence of the amplitude, period, time, and coefficient of attenuation of the oscillations on the applied electromagnetic force. (tr-auth)

22483 ONE PROBLEM OF A FLOW PAST BODIES IN MHD. Legeida, V. I. Magn. Gidrodin.; No. 1, 145-148(1973). (In Russian).

The problem of the streamline flow of an arbitrary plane profile in a magnetic field perpendicular to the current plane was examined. In the case of irrotational streamline flow the problem is reduced to the integral second-order Fredholm equation. A numerical solution of the problem was obtained for the streamline flow of circular cylinders. (tr-auth)

22484 NON-NEWTONIAN FLUID MHD PIPE FLOW. Makarov, A. M.; Martinson, L. K.; Romanovskii, M. R.; Simkhovich, S. L. Magn. Gidrodin.; No. 1, 148-150(1973). (In Russian).

The gradient flow of a non-Newtonian fluid with stepwise rheological law and volumetric density of the electric charge in a pipe under the effect of an external homogeneous electric field was examined. The distributions of the volumetric density of the electric charge, induction field, and velocity of the medium were obtained. The possibility of the formation of zones of reverse flow was shown. The boundary transitions to Newtonian fluid and uncharged fluids with a stepwise rheological law were obtained. (tr-auth)

22485 LIMIT BEHAVIOR OF A CLASS OF MHD FLOWS UNDER THE ACTION OF STRONG MAGNETIC FIELDS. Hartmann, C.; Sanchez-Palencia, E. (Univ., Paris). Magn. Gidrodin.; No. 1, 3-11(1973). (In Russian).

A rigorous mathematical basis is given for the fact that in flat and axisymmetrical steady MHD flow at $Ha \to \infty$ and $Re = const$. all resolutions of the boundary value problem (and these can be several) converge to a unique solution of the boundary problem, showing a degenerate Stokes problem. The examination was based on the concept of the generalized solution and the method of functional analysis. (tr-auth)

22486 EXPERIMENTAL STUDY OF THE PRESSURE DISTRIBUTION IN A CONSTRICTED MHD FLOW PAST CYLINDERS. Tsinober, A. B.; Shtern, P. G. Magn. Gidrodin.; No. 1, 12-18 (1973). (In Russian).

A measurement was made of the pressure distribution along the walls of a rectangular channel, in which a circular cylinder was installed, during the flow of Hg in a transverse magnetic field. It was established that in a sufficiently strong magnetic field the flow is converted into Stokes flow. The criterion of the transition to this regime was determined experimentally. Confirmation was obtained of the existence of a layer of the Ladford type in the region of abrupt change of the geometry of the boundary flow in the strong magnetic field. The effect of containment of the flow on the pressure distribution along the walls of the channel was investigated. (tr-auth)

22487 EXPERIMENTAL STUDY OF THE EFFECT OF A MAGNETIC FIELD ON THE TURBULENCE BEHIND THE GRID. Volkov, A. V. Magn. Gidrodin.; No. 1, 26-32(1973). (In Russian).

By means of a hot-wire anemometer, the grid turbulence, inserted in a magnetic field, was investigated. The rearrangement of the structure of the turbulence and its attenuation were derived. At high levels of turbulence the Joule dissipation is great and the rate of attenuation of the turbulence at some times is higher than without a field. Subsequently in reduction of the intensity of the turbulence, the rate of the attenuation abruptly decreases which indicates a decrease of the role of the Joule dissipation. (tr-auth)

22488 APPLICATION OF A PULSATION ENERGY BALANCE EQUATION IN THE THEORY OF MHD PIPE AND CHANNEL FLOWS. Tul'vert, V. F. Magn. Gidrodin.; No. 1, 33-37(1973). (In Russian).

The turbulent flow of incompressible conducting fluids in circular pipes and flat channels in a longitudinal magnetic field was investigated. This problem was solved by the joint integration of equations of motion and balance of pulsation energy. For coefficients of turbulent viscosity and scaling ratio of length the same hypotheses were used as for flow in absence of magnetic fields. The empirical coefficient, entering into the expression for the Joule dissipation of the turbulent energy, assumes equal values, used during the calculation of the current flow of the conducting fluid. The distributions of the mean kinetic energy of the turbulent pulsation, rate of the average flow, and coefficient of the hydraulic resistance were found. (tr-auth)

22489 MOTION OF A SPHERE IN A CONDUCTING FLUID IN THE PRESENCE OF CROSSED ELECTRIC AND MAGNETIC FIELDS. Merkulov, V. I. Magn. Gidrodin.; No. 1, 38-42(1973). (In Russian).

A calculation was made of the force originating in a conducting fluid under the influence of crossed electric and magnetic multifields. By use of the experimental coefficients of resistance of the motion of the sphere, the velocities of the motion of the sphere under the influence of the indicated force were calculated. The induction resistance of the moving fluid was calculated under the assumption of uninterrupted streamline. The efficiency of this method of obtaining the force, which grows with increase of the dimensions of the sphere, was shown. A numerical example for the motion of the sphere in salt water under the influence of electric and magnetic dipoles gave an efficiency of only 7%. (tr-auth)

22490 PERIODICAL CONDUCTING FLUID FLOW IN THE TRAVELING MAGNETIC FIELD. Merkulov, V. I.; Tkachenko,

V. F.; Yatsenko, V. I. Magn. Gidrodin.; No. 1, 43-48(1973). (In Russian).

Numerically by the net-point method, the plane periodic flow of an inviscid fluid in a traveling field (with given tangential induction components) or in fields having superposition of longitudinal constant and traveling field, was investigated. On the basis of this method solutions of a nonlinear system of magnetohydrodynamic equations were obtained clearly of the second order of precision of different schemes. The evolution of the flow under the influence of the traveling field was examined from the original state of rest in the channel with zero consumption. The dependence of the character of the motion of the fluid on the dimensionless parameters characterizing the channel and magnetic field (width of the channel, phase displacement, parameter of the magnetic pressure) was examined. It was shown that the traveling magnetic field forms in the conducting fluid a closed induction (secondary) flow as a result of which the movement in the infinite channel has a periodic structure. Circulation zones incline towards a given position relative to the inductor and lead to a regulated agitation of the fluid. In purely traveling fields the areas of circulation were distributed between themselves at a distance of polar steps. In longitudinal fields the appearance and evolution of circulating motion occur intensely but the period of their recurrence equals the length of the wave of the traveling field (doubled polar step). In conforming and counter connection of the inductor the flow is symmetrical with relation to the channel axis but in a steady magnetic field it is nonsymmetrical. (tr-auth)

22491 APPLICATION OF THE CHARACTERISTICS METHOD FOR THE SOLUTION OF THE BOUNDARY LAYER PROBLEM. Karyakin, Yu. E.; Karyakin, V. E.; Demidova, T. V. Magn. Gidrodin.; No. 1, 49-55(1973). (In Russian).

The application of the characteristics method to the solution of the universal equations of a plane MHD boundary layer of an incompressible fluid in a transverse magnetic field was investigated. A system of characteristic universal equations introduces its set of curves, coming from a particular point of the modal type. Along each of the characteristics the universal equation was reduced to an association of equations in individual derivatives with two separate variables and systems of ordinary differential equations. It was shown that the singular explicit universal equation was resolved into two-parameter approximation. For this the characteristics represented rays coming from the particular point $f_1 = \kappa_1 = 0$. In the two-parameter approximation the equation was integrated on the IBM. Graphs of the universal functions were obtained and methods were indicated for the solution of the concrete problems on the moving conducting fluid in the boundary layer. (tr-auth)

22492 FERROMAGNETIC FLUID FLOW IN MAGNETIC FIELDS. Mozgovoi, E. N.; Blum, E. Ya.; Tsebers, A. O. Magn. Gidrodin.; No. 1, 61-67(1973). (In Russian).

The results were reported of an investigation of the isothermal flow of a finely dispersed suspension of iron in toluene in circular and plane-parallel channels. It was shown that the imposition of a homogeneous magnetic field on the flow leads to an increase of the observed viscosity. The contribution of the field to the increase of the friction depends both on the volumetric portion of the discrete phases and on the size and orientation of the field relative to the channel. The experimental results were considered from the viewpoint of the hydrodynamics of the fluid system with internal rotation of the particles, having a constant magnetic moment. The results agree with the theoretical predictions. It was noted that the measurement of the effective viscosity in the magnetic field can be used for the investigation of the physico-chemical structure of colloidal solutions. (tr-auth)

22493 MOTION OF A MAGNETIZING LIQUID BETWEEN PARALLEL PLANES. Isers, A. B.; Tarapov, I. E. Magn. Gidrodin.; No. 1, 73-78(1973). (In Russian).

The steady motion of an incompressible magnetizing liquid between fixed infinite planes in an external magnetic field was examined. The magnetic field has a constant gradient in the direction of the liquid motion. Curves were obtained for the distributions of the velocities and temperatures in the gap. The possibility of constructing an MHD device on the basis of this problem was examined. Coefficients of the efficiency of such devices were calculated. (tr-auth)

22494 LAMINAR STRIATED CONDUCTING FLUID FLOW IN ANNULAR CHANNELS AT LARGE MHD INTERACTION PARAMETERS. Bertinov, A. I.; Kovalev, L. K.; Koneev, S. M. A.; Poltavets, V. N. Magn. Gidrodin.; No. 1, 79-84(1973). (In Russian).

A viscous laminated axis-symmetrical flow of a conducting fluid at large MHD interaction parameters was investigated in annular channels with curved walls. The viscosity, density, and conductivity of the medium were calculated with step functions of transverse coordinates at the inlet to the channel. Analytical solutions were obtained for the problem on the three-layer flow in the annular channel with consideration of the blast across the porous walls when the given external axis-symmetrical field satisfies the Maxwell equation. An investigation was made on the influence of the relative magnitude of the density, conductivity, and viscosity on the structure of the flow in the boundary zone and in the center of the current at large MHD interaction parameters. (tr-auth)

22495 SPREADING OF A CONDUCTING FLUID JET ALONG THE PLANE SURFACE IN A STRONG LONGITUDINAL MAGNETIC FIELD. Gorbachev, L. P.; Potanin, E. P. Magn. Gidrodin.; No. 4, 140-142(1972). (In Russian).

The laminar jet of a viscous electroconducting fluid, being propagated along a solid flat surface in a strong longitudinal magnetic field, was investigated. The electric currents were assumed short-circuited. The inducting magnetic fields were neglected. In the approximation of the theory of boundary layers, a solution was obtained for a system of MHD equations. The characteristic singularities of the solution seemed the existence of a countercurrent in the outer part of the jet. (tr-auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 21361.

22496 (ORO-2504-208) HIGH ENERGY ACCELERATOR AND COLLIDING BEAM USER GROUP. Progress Report, 1972-1973. Technical Report 74-001. Glasser, R. G. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jul 1973. Contract AT(40-1)-2504. 30p. Dep. NTIS $3.50.

Experimental research on particle interactions and properties is briefly summarized. A list of publications is included. (JFP)

22497 (ORO-2504-209) HIGH ENERGY ACCELERATOR AND COLLIDING BEAM USER GROUP. Progress Report. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jul 1973. Contract AT(40-1)-2504. 31p. Dep. NTIS $3.75.

Experimental research in high energy physics is summarized. A list of publications is included. (JFP)

22498 (RHEL/R-270) WORK OF THE RUTHERFORD LABORATORY IN 1972. Smith, J. R.; Telling, F. M. (Rutherford High Energy Lab., Chilton (England)). May 1973. 214p. Dep. NTIS (U. S. Sales Only) $12.75.

The work carried out in the Rutherford Laboratory during 1972 is described under the following headings: high energy physics (use of electronic techniques, bubble chamber experiments, nuclear structure); accelerator operations and development (Nimrod); instrumentation for high energy physics; applied research (superconducting magnets, polarized targets); neutron beam research and computer systems and applications. A list of publications and lectures is also given. (UK)

22499 (WASH-1263) GOALS AND ACHIEVEMENTS IN HIGH ENERGY PHYSICS. (Division of Physical Research (AEC), Washington, D. C.). Jun 1973. 24p. GPO $0.35.

The summary of high energy physics includes atomic, nuclear, and subnuclear matter, deep inelastic electron–proton scattering, electron–positron colliding beams, proton–proton collisions, universal behavior at high energies, heavy ion research, beam fragmentation, neutrinos, unified theories of weak and electromagnetic interactions, and high energy physics and astronomy. (JFP)

Electromagnetic

22500 EXPERIMENTAL EVIDENCE OF A SMALL LEFT–RIGHT HAND ASYMMETRY IN THE COMPTON SCATTERING BY TRANSVERSALLY POLARIZED ELECTRONS. Dragomirescu, D.; Kanya, C. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 5, 637-646(1973).

An experimental check of a theoretical hypothesis of the quantum electrodynamics is given. The aim was to measure a small asymmetry produced by the radiative correction. This asymmetry appears in the Compton scattering of gamma rays on transversally polarized electrons. The experimental asymmetry $A_{exp} = (2.48 \pm 0.29) \times 10^{-6}$ fits within errors the theoretical one, calculated for the particular geometry $A_{th} = (3.06 \pm 0.26) \times 10^{-6}$. This result justifies the correctness of the theory, particularly, the correctness of the method of calculation of the radiation correction. A high intensity gamma ray source was used to obtain good statistics. The stability problems were solved by using good quality electronics and a special sequence of the measurements. This experiment is meaningful not only by the results obtained, but also by the methods used. Particularly one can use these methods and this way to solve problems, in some other more meaningful experiments. (auth)

22501 ACOPLANAR (e^+e^-) PAIRS AND RADIATIVE CORRECTIONS. Bernardini, M.; Bollini, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (CERN, Geneva). Phys. Lett.; 45B: No. 2, 169-170(9 Jul 1973).

Further proof is given for the inadequacy of the peaking approximation in first-order radiative corrections, via the observation of 429 noncoplanar (e^+e^-) events. The energy dependence of these effects is measured in the s-range 1.44 to 9.0 GeV^2, and represents another proof of the validity of QED. (auth)

22502 π^- PRODUCTION WITH LINEARLY POLARIZED PHOTONS AT 3.4 GeV. Burfeindt, H.; Buschhorn, G.; Geweniger, C.; Kotthaus, R.; Skronn, H. J.; Wahl, H.; Wegener, K. (Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Phys.; B59: No. 1, 87-92(1973).

The asymmetry of the reaction $\gamma d \rightarrow \pi^- p\,(p_s)$ with linearly polarized photons was measured at 3.4 GeV and momentum transfers $\sqrt{-t}$ between 0.2 and 0.8 GeV/c. As in π^+ production, the asymmetry is large and positive at small momentum transfers but drops rapidly with increasing $\sqrt{-t}$, crossing zero around $\sqrt{-t} = 0.55$ GeV/c. (auth)

22503 INVESTIGATION OF TRANSITION RADIATION IN FOAMED PLASTIC. Alikhanyan, A. I.; Belyakov, E. S.; Lorikyan, M. P.; Markaryan, K. Zh.; Shikhlyarov, K. K. JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 325-327(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 453-456(5 May 1973).

The properties of the differential spectra of transition radiation in foamed plastic for electrons of varying energies are found. (JFP)

Weak

22504 (COO-2232-11-Ex) PROPOSAL FOR A CONTINUATION WITH INCREASED SENSITIVITY OF THE SEARCH FOR $e^{\pm}$, e^+e^- PAIRS, HIGH TRANSVERSE MOMENTUM $\pi^{\pm 0}$, AND MULTIPLE PION CORRELATIONS IN COLLISIONS WITH HIGH TRANSVERSE MOMENTUM. Blumenfeld, B. J.; Buesser, F. W.; Camilleri, L.; Cool, R. L.; Di Lella, L.; Lederman, L. M.; Pope, B. G.; Rothenberg, A. F.; Segler, S. L.; Smith, A. M.; Tannenbaum, M. J. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York; Rockefeller Univ., New York). 14 May 1973. 16p. Dep. NTIS $3.00.

The physics rational and experimental arrangements are described for a proposed experiment for a search for dileptons in p + p collisions in colliding beams. (JFP)

Strong (Baryon-induced)

Refer also to abstract 22639.

22505 (CNRS-CBH-72-4) ELASTIC $\bar{p}d$ SCATTERING AT 5.55 INCIDENT MOMENTUM. Braun, H.; Fridman, A.; Jegham, E.; Juillot, P.; Malko, J. A.; Voltolini, C.; Charlton, G. R.; Cooper, W. A.; Musgrave, B. (Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Recherches Nucleaires). 1972. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

An analysis of the elastic $\bar{p}d$ scattering reaction is presented. Because it was possible to measure small deuteron recoils the measurements are limited to elastic cross section in the momentum transfer region, $t > 0.03$ $(GeV/c)^2$. Extrapolation toward small t by two different methods led to two compatible estimates of the total elastic cross section. The differential cross section was analyzed by means of the Glauber formalism both with and without the effects due to the D-wave part of the deuteron wave function. The differential cross sections of np at 5.4 GeV/c and $\bar{p}n$ deduced from the data are compared; they exhibit a cross over phenomenon. (auth)

22506 (COO-2232-12-EX) PROTON–PROTON AND PROTON–DEUTERON ELASTIC SCATTERING EXPERIMENTS AT NAL. Cool, R. L. (Rockefeller Univ., New York). 15 May 1973. 18p. (CONF-730556-1). Dep. NTIS $3.00.

From meeting of the royal society; London, UK (15 May 1973).

Differential cross sections for pp and pd elastic scattering were measured at NAL for $80 < s < 600$ $(GeV)^2$ in the four-momentum transfer range $0.001 < |t| < 0.15$ $(GeV/c)^2$. Preliminary values are given for the slope parameters in the diffraction region and for the ratio of the real to the imaginary scattering amplitude. The energy dependence of these parameters is discussed. (auth)

22507 SPECIAL FEATURES OF HIGH ENERGY HADRONS IN AIR SHOWERS. Vatcha, R. H.; Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 6: No. 7, 1050-1066(Jul 1973).

The properties of hadrons of energy 2.5×10^{10} to 10^{13} eV in air showers of size 5×10^4 to 3×10^6 particles at 800 g cm^{-2} were studied using a 2 m^2 multiplate cloud chamber as the hadron detector operated at the center of the Tata Institute of Fundamental Research air shower array at Ootacamund. The results show a tendency for the lateral distribution of high energy hadrons to flatten with increasing shower size. The energy spectrum in the range 50 to 800 GeV steepens continuously with size, and the number of hadrons does not increase linearly with size, but at a much slower rate especially for high energy hadrons. The frac-

tional energy spectrum of hadrons of energies greater than 200 GeV is different for showers of size less than and greater than 3×10^5 particles. The charge to neutral ratio of hadrons of energy greater than 25 GeV in showers of size less than 3.2×10^5 is found to have a rather low value (6.2 ± 1.3), and there is evidence for a further decrease in this value for larger size showers. A comparison of the present results with those of others is presented. (auth)

22508 EXPERIMENTAL INVESTIGATIONS OF HYPERNUCLEI. Bom, G.; Krekker, U. Fiz. Elem. Chastits At. Yadra; 3: No. 2, 318-365(1972). (In Russian).

Investigations of hypernuclei, performed up to the present predominantly by the nuclear emulsion method, are reviewed. In particular, binding energy, spin, decay modes and final state interactions are considered. Finally, the problem of excited states of hypernuclei is discussed. (auth)

22509 ENERGY–MOMENTUM CONSERVATION EFFECTS IN THE INCLUSIVE TWO-PARTICLE CORRELATION FROM 18 GeV/c TO ISR ENERGY. Korosuo, O.; Sohlo, S. Lett. Nuovo Cim.; 7: No. 15, 753-759(11 Aug 1973).

The experimental inclusive two-particle correlations are compared at different energies with the kinematical correlation function from an uncorrelated jet model with transverse-momentum cut-off. A dynamical correlation length was determined at energies of 18.5 to 500 GeV/c. The experimental data for the rapidity correlations are discussed for the reactions $\pi^+ + p$, $\pi^- + p$, $p + p$ and $K^+ + p$. (JFP)

22510 NEUTRON–NEUTRON AND NEUTRON–PROTON FINAL-STATE INTERACTION IN THE NUCLEAR REACTION $^2H(n,2n)p$. Maschuw, R. Hamburg; Univ. Hamburg (1971). 52p. (In German).

Thesis.

A kinematically complete experiment for investigating the reaction $^2H(n,2n)p$ is described. The neutron–neutron and the neutron–proton interactions in the final state have been investigated under almost identical kinematic conditions in order to determine the nucleon–nucleon scattering parameter. From this, the scattering lengths a(nn) and a(np) have been determined to be a(nn) = −16.5 ± fm, and a(np) = −23.716 ± 0.0127 fm. (GE)

22511 ELASTIC SCATTERING IN THE REGION OF THE COULOMB INTERFERENCE AT MOMENTA 1.1 TO 1.7 GeV/c. Vorob'ev, A. A.; Denisov, A. S.; Zalite, Yu. K.; Korolev, G. A.; Korolev, V. A.; Kovshevnyi, G. G.; Maev, E. M.; Medvedev, V. I.; Sokolov, G. L.; Solyakin, G. E.; Spiridenkov, E. M.; Tkach, I. I.; Shchegel'skii, V. A. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 17: No. 3, 108-110(5 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 3, 154-158(5 Feb 1973).

The differential small-angle pp scattering cross section was measured using a new method in which a pulsed ionization chamber filled with hydrogen served simultaneously as a gas target and as a recoil-proton detector. The interference formula was used to determine the ratio of the real part of the spin-independent forward scattering amplitude to the imaginary part. The experimental data are found to agree well with the theoretical calculations based on dispersion relations. (LBS)

Strong (Meson-induced)

Refer also to abstracts 22614, 22750, and 22775.

22512 (CEA-N-1600, pp 176-177) MEASUREMENT OF THE $\pi^- + p \rightarrow \pi^0 + n$ CHARGE EXCHANGE CROSS SECTION. Bertin, P.; Coupat, B.; Duclos, J.; Gerard, A.; Magnon, A.; Miller, J.; Morgenstern, J.; Vernin, P. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The charge exchange cross section ($\pi^- + p \rightarrow \pi^0 + n$) was measured for low energy pions (22.6, 32.9, and 42.6 MeV). The recoil neutrons, detected by plastic scintillators, were identified by their times of flight. The value of the s scattering length difference $a_3 - a_1 = 0.275 \pm 0.014$ was deduced from these measurements. (auth)

22513 (COO-1545-130) SEARCH FOR STRUCTURE IN π-p → ΛK THRESHOLD. Nelson, B.; Knasel, T. M.; Lindquist, J. (Ohio State Univ., Columbus). Jun 1973. Contract AT(11-1)-1545. 12p. Dep. NTIS $3.00.

The cross section, the angular distribution, and the lambda polarization for the reaction $\pi^- p \rightarrow \Lambda K^0$ were measured. A spark chamber spectrometer was used to collect 8400 ΛK^0 events at 14 beam momenta near ΣK threshold. The data do not show the prominent cross section enhancement suggested by some previous experiments. However, detailed structure in the cross section and the angular distribution agrees well with a simple model which includes a cusp effect at ΣK threshold. (auth)

22514 (COO-3130-TB-182) PROGRESS REPORT OF A RESEARCH PROGRAM IN EXPERIMENTAL HIGH ENERGY PHYSICS. Shapiro, A. M.; Lanou, R. E. Jr. (Brown Univ., Providence, R. I. Dept. of Physics). 1 Jun 1973. Contract AT(11-1)-3130. 42p. Dep. NTIS $4.25.

Experimental research on strong interactions is summarized. A list of publications is included. (JFP)

22515 (JINR-P1-7267) PRODUCTION OF NEUTRAL STRANGE PARTICLES IN π^-p-, π^-n-, AND π^-C-INTERACTIONS AT 40 GeV/c. Budapest-Bucharest-Dubna-Kharkov-Sofia-Tashkent-Tbilisi-Ulan-Bator-Hanoi Collaboration (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 35p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.75.

Neutral strange particle production in π^-p-, π^-n-, and π^-C-interactions was studied. Inclusive cross sections of $\Lambda(\Sigma^0)$-hyperon and K^0-meson production are obtained. It is noted the increase of $\sigma^{\pi^-p}_{\Lambda(\Sigma^0)} + \ldots$ approximately by two times as compared with the data in the energy range of 10 to 25 GeV. Inclusive spectra of Λ- and K^0_1-particles are given. Values of normalized invariant cross sections of Λ-hyperons and K^0_1-mesons for π^-pp-interactions at 40 GeV/c are compared with the corresponding cross sections for π^-p-interactions at smaller energies and for pp-interactions at 205 GeV. (auth)

22516 PRODUCTION OF γ QUANTA IN π-N INTERACTIONS AT 40 GeV/c. Budapest–Bucharest–Warsaw–Dubna–Krakow–Serpukhov–Sofia–Tashkent–Tbilisi–Ulhan–Bator–Hanoi Collaboration. Yadern. Fiz.; 17: No. 6, 1235-1244(Jun 1973). (In Russian).

The data are presented on the average multiplicity of π^0 mesons in the π^-n, π^-p, and π^-C interactions at 40 GeV/c momentum for 9432 γ events. The average number of π^0 mesons increases as a function of multiplicity of charged particles. The average momentum and angular characteristics of the γ quanta are given in the laboratory and center-of-mass systems. The average transverse momentum of the γ quanta is constant in a wide energy range for the π^-p and pp interactions. A plateau in the distribution $\sigma^{-1}_{in}(d\sigma/dy^*) = f(y^*)$ of the γ quanta from the π^-p interactions is observed for $-1 \lesssim y^* \lesssim 1$. The absolute value of the cross section in the region $y^* = 0$ coincides with the corresponding cross section for pp interactions at $E_p = 500$ to 1500 GeV. There is a scaling in the central region $y^* = 0$ for the interactions at p = 40 GeV/c if the prediction is valid that the absolute values of $f(y^*)$ do not depend on the kind of the colliding particles at small y^*. (auth)

22517 MEASUREMENT OF THE CROSS SECTION OF THE REACTION $K^-p \rightarrow \bar{K}^0n$ AT 25 GeV/c. Belousov, V. I.; Dmitrevskii, Yu. P.; Karpekov, Yu. D.; Kachanov, V. A.; Konstantinov, V. F.; Kut'in, V. M.; Lednev, A. A.; Makarov, G. P.; Prokoshkin, Yu. D.; Prokhorov, A. N.; Sergeev, V. A.; Simonov, Yu. N.; Sugonyaev, V. P. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 6, 1225-1229(Jun 1973). (In Russian).

The results are presented of measurement of the charge exchange reaction $K^-p \rightarrow \bar{K}^0n$ cross section at 25 GeV/c momentum. The reaction events are identified by means of precise measurement of the decay angle for $K^0_2 \rightarrow \pi^+\pi^-$. (auth)

22518 INCLUSIVE REACTIONS IN π^-p INTERACTIONS AT 21 GeV. Balea, E. (Inst. of Atomic Physics, Bucharest); Balea, O.; Boldea, V.; Cristea, D.; Felea, S.; Nicorovici, N.; Pantea, D.; Ponta, T.; Besliu; Cotorobai, F.; Cirstea, N. Rev. Roum. Phys.; 18: No. 4, 483-492(1973).

Some phenomenological aspects concerning the transverse and the longitudinal momenta, the Feynmann's variable, the rapidity and the missing mass distributions for inclusive reactions $\pi^-p \rightarrow \pi^-(K^0,\Lambda) + X$ at 21.3 GeV are reported. (auth)

22519 REACTION $\pi^+n \rightarrow \omega p$ AT 6.0 GeV/c. Anderson, J. C. (Carnegie–Mellon Univ., Pittsburgh); Engler, A.; Kraemer, R. W.; Toaff, S.; Weisser, F.; Diaz, J.; DiBianca, F.; Fickinger, W.; Robinson, D. K. Phys. Lett.; 45B: No. 2, 165-168(9 Jul 1973).

An analysis of the reaction $\pi^+n \rightarrow \omega p$ in a 6.0 GeV/c bubble chamber experiment is presented. The production differential cross section and spin density matrix elements are compared with Regge exchange models. (auth)

22520 FLUCTUATIONS IN LARGE-ANGLE πp ELASTIC SCATTERING AT 5 GeV/c. Schmidt, F. H. (Univ. of Washington, Seattle); Baglin, C.; Carlson, P. J.; Eide, A.; Gracco, V.; Johansson, E.; Lundby, A. (Univ. of Washington, Seattle). Phys. Lett.; 45B: No. 2, 157-160(9 Jul 1973).

In a re-analysis of large-angle $\pi^\pm p$ elastic scattering cross sections at 5 GeV/c the data were divided in two momentum bins separated by approximately 80 MeV/c. For π^+p the differential

cross sections are found to fluctuate considerably between the two momentum bins, whereas for π^-p no fluctuations are observed. The result is interpreted as possible evidence for Ericson fluctuations. (auth)

22521 MISSING MASS ANALYSIS OF THE A_2^- AT 6.0 GeV/c. Conforto, G. (Univ. of Chicago); Kramer, M. A.; Underwood, D.; Mobley, R. M.; Key, A. W.; Prepost, R.; Tompkins, D. H.; Witherell, M. S. AT(11-1)-881-354. Phys. Lett.; 45B: No. 2, 154-156(9 Jul 1973).

The missing mass spectrum in the region of the A_2^- was measured in the reaction $\pi^-p \rightarrow X^-p$ at 6.0 GeV/c in the interval $0.27 < |t| < 0.42$ $(GeV/c)^2$, with an optical spark chamber system which simultaneously observed the decay $X^- \rightarrow \eta\pi^-$. A signal of 230 events above background per five MeV interval is observed at the A_2 peak, with a signal-to-background ratio of greater than 1:1. A single D-wave Breit–Wigner distribution with a quadratic background gives a good fit to the data, yielding the parameters $M_0 = (1.324 \pm 0.003)$ GeV/c^2 and $\Gamma_0 = (0.104 \pm 0.009)$ GeV/c^2. The spectrum is incompatible with a dipole shape. (auth)

22522 ANALYSIS OF DATA FOR THE HYPERCHARGE-EXCHANGE REACTIONS. Irving, A. C. (CERN, Geneva); Martin, A. D.; Barger, V. Nuovo Cim.; 16A: No. 4, 573-597 (21 Aug 1973).

The properties of the experimental data on the hypercharge-exchange reactions $\pi N \rightarrow K\Sigma$, $K\Lambda$ and $\bar{K}N \rightarrow \pi\Sigma$, $\pi\Lambda$ in the region (4 to 16) GeV/c are surveyed, with attention to line-reversal inequalities, reaction energy dependences in terms of effective trajectories, phase-energy properties, and SU_3 for exchanges. The s-channel helicity nonflip amplitudes at 4 and 14 GeV/c are determined, assuming an exchange degenerate $K_V^*-K_T^*$ Regge-pole approximation for the flip amplitudes. In the impact-parameter representation only the imaginary parts of the $\pi N \rightarrow KY$ nonflip amplitudes (or in terms of exchanges Im K_V^*) are found to be peripheral. All other nonflip amplitude components are central. An SU_3 comparison is made with $K^-p \rightarrow \eta\Lambda, \eta'\Lambda$ data. (auth)

22523 HELICITY CONSERVATION IN THE REACTION $\pi^-p \rightarrow A_1p$ AT 4.45 GEV/C. Beketov, G. V.; Zombkovskii, S. M.; Kaidalov, A. B.; Konovalov, B. S.; Kruchinin, S. P.; Poyidaeva, N. A.; Selector, Ya. M.; Shulyachenko, V. N.; Turov, V. F. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys., B59: No. 1, 265-272(1973).

Helicity conservation in the reaction $\pi^-p \rightarrow pA_1$ at 4.45 GeV/c was studied using 50 cm and 55 cm liquid hydrogen bubble chambers. In the Jackson and the helicity frames the dependence of the ρ matrix elements on the four-momentum transfer squared to the proton (t) for A_1 maximum decay has been calculated. The obtained data are in a good agreement with t-channel helicity conservation. The t-channel dependence of the ρ matrix elements in the mentioned frames is in good agreement with that calculated using the Regge π-pole exchange model (it is suggested that the A_1 maximum nature is explained by a kinematical effect of the Deck type). (auth)

22524 ENERGY DEPENDENCE OF COHERENT PRODUCTION OF THREE PIONS ON NUCLEI BETWEEN 9 AND 15 GeV AND COMPARISON WITH DIFFRACTIVE THREE-PION PRODUCTION ON HYDROGEN. Muehlemann, P. (Eidgenoessische Technische Hochschule, Zurich); Freudenreich, K.; Gentit, F. X.; Bellini, G.; Di Corato, M.; Vegni, G.; Bemporad, C.; Beusch, W.; Polgar, E.; Websdale, D.; Astbury, P.; Lee, J. G.; Letheren, M. Nucl. Phys., B59: No. 1, 106-127(1973).

On the basis of 34,000 coherent events, produced on different target nuclei and at incident pion momenta from 9 to 15 GeV/c, the energy dependence of the differential cross section and of the three-pion mass spectrum is discussed. The comparison with the optical model is satisfactory. This model is then used to determine the total cross section of the unstable three-pion system on nucleons; the result is a value of about 25 mb. The value of the forward differential cross section on nucleons obtained by application of the optical model shows a tendency to increase with incident energy. A similar increase with energy is found for the forward diffractive cross section of three-pion production on hydrogen; the absolute value of this cross section is somewhat higher than the cross section determined from nuclear targets. Also the mass spectrum on nucleons derived from the present experiment is compatible with that produced on hydrogen. Furthermore, there is no evidence for abundant coherent production of A_2 and A_3. On the other hand, these two resonances seem to be present in the incoherent background. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 23331.

22525 (COO-3130-TA-278) TOPICS IN THE INCLUSIVE PHENOMENOLOGY. Kang, K. (Brown Univ., Providence, R. I.; Paris Univ. (France). Laboratoire de Physique Nucleaire et de Hautes Energies). 1972. Contract AT(11-1)-3130. 76p. Dep. NTIS $6.00.

The topics discussed in inclusive phenomenology include: exclusive and inclusive cross sections; inclusive sum rules and elementary consequences; inclusive and exclusive functionals; known properties in experiments; kinematics and choice of variables; hypothesis of scaling and limiting fragmentation; Feynman–Wilson gas analog; Mueller's Regge hypothesis; energy dependence of the inclusive cross sections; single-particle production in the dual resonance model; and further analysis of the dual resonance model. (LBS)

22526 (FRNC-R-20, pp IV.29-IV.39) QUANTISATION, A MEETING POINT FOR MATHEMATICIANS AND PHYSICISTS. Bacry, H. (CNRS, Marseille). 1972.

The relation between mathematical and physical quantization is examined. (auth)

22527 (ITF-72-80) RENORMALIZED HAMILTONIAN IN THE RUIJGROUK AND VAN HOVE MODEL. Burban, I. M. (Akademiya Nauk Ukrainskoi SSR, Kiev). Institut Teoreticheskoi Fiziki). 1972. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The Ruijgrouk and Van Hove model with relativistic kinematics is investigated. It is proved that by a corresponding choice of renormalization counter terms the Hamiltonian of the system can be interpreted as a symmetric operator approximated by a strongly convergent sequence of operators in the Fock space which are cut in the ultraviolet region. (auth)

22528 (ORO-2504-207) DISTRIBUTION OF TRANSVERSE MOMENTUM. Technical Report 73-144. Glasser, R. G. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jun 1973. 3p. Dep. NTIS $3.00.

If a system is symmetric under rotations about an axis the distribution of momentum transverse to this axis may be inferred from the distribution of the momentum projected on any direction transverse to the axis. This relation is useful in dealing with the distribution of inclusive neutral pion momenta derived from inclusive γ momentum distributions. (auth)

22529 (ORO-3992-121) SEMI-INCLUSIVE SCALING IN THE INDEPENDENT CLUSTER EMISSION MODEL. Chiu, C. B.; Wang, K. H. (Texas Univ., Austin. Center for Particle Theory). 1973. Contract AT(40-1)-3992. 18p. (CPT-67). Dep. NTIS $3.00.

Simple schemes are discussed within the framework of the independent cluster emission model, which give rise to KNO (semi-inclusive) scaling in the pion multiplicity distribution and reproduce the experimental scaling curve with one parameter. (auth)

22530 APPROXIMATION FOR RESONANT INTERACTION OF PARTICLES AT LOW ENERGY. Andrusenko, N. P.; Grashin, A. F. (Moscow Regional Teacher's Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 36-40(1973). (In Russian).

By means of assumptions made earlier, equations were obtained for the approximate formula for the scattering amplitude at low energies. The interrelation of the scattering length and the effective radius with parameters characterizing the potential of the strong interaction $V(q^2)$ at small values the momentum transfer q^2 was established. (tr-auth)

22531 PHYSICS OF ELEMENTARY PARTICLES. Tassie, L. J. New York; John Wiley and Sons, Inc. (1973). 264p. $10.50.

The topics covered are pion, nucleon, and other particle properties, magnetic moments, strange particles, nonconservation of parity, leptons, neutral kaons and nonconservation of CP, resonances, SU(3) multiplets of hadrons, Regge poles, SU(6), and electromagnetic interactions. (JFP)

22532 GRAVITATIONAL INTERACTIONS OF THE PROTON AND THE ELECTRON: THE POSSIBLE EXISTENCE OF A MASSLESS SCALAR PARTICLE. Hayashi, K. (Max-Planck Institut fuer Physik und Astrophysik, Munich). Nuovo Cim., 16A: No. 4, 639-673(21 Aug 1973).

Assuming general covariance, the structure of gravitational interactions between the proton and the electron is discussed. There are 15 (3) different couplings between a massive spin-$\frac{1}{2}$ particle (a two-component neutrino) and the gravitational field, provided that interactions involve no higher derivatives than those appearing in the free Dirac and gravitational Lagrangians. In the weak-field limit the interactions may be divided into 4 classes: (C, P, T) = (+, +, +), (+, −, −), (−, +, −) and (−, −, +). Any deviation from Einstein's theory entails an asymmetric energy-momentum tensor, hence involving hypothetical massless, spinless particles,

represented by a skewsymmetric tensor field whose source is the spin of the proton and the electron. Possible effects of this particle on the hyperfine structure of the hydrogen atom are also discussed. (auth)

22533 RECENT DEVELOPMENT IN HIGH ENERGY PHYSICS. Van Hove, L. (CERN, Geneva). Cesk. Cas. Fys.; 23: No. 4, 377-393(1973). (In Czech).

Five topics selected for the fact that they have been marked by significant progress in the last three years are discussed: renormalization theory, violation of time reversal invariance, evidence of a granular structure of the proton, high energy collisions of hadrons, propagation of hadronic systems through nuclear matter. Each topic is presented briefly and in general terms, emphasizing aspects which are thought to be relevant for an audience of physicists not specialized in the high energy field. (auth)

22534 PARTICLE PHYSICS. DeWitt, C.; Itzykson, C. (eds.). Summer School of Theoretical Physics, Universite de Grenoble. New York; Gordon and Breach, Science Publishers, Inc. (1973). 552p.

Ten lectures are included; a separate abstract is prepared for each lecture. (LBS)

For abstracts of individual lectures see: 21365, 22536, 22537, 22566, 22597, 22598, 22657, 22663, 22678, and 23331.

22535 FLUCTUATION THEOREMS FOR THE FEYNMAN FLUID MODEL OF INCLUSIVE REACTIONS. Gupta, V.; Singh, V. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 7: No. 15, 775-778(11 Aug 1973).

Some exact results pertaining to the Mueller formulation of the Feynman one-dimensional classical fluid analog for high energy multiproduction are given. The results show this particular formulation of the fluid analog to be untenable. Comments are made on the general fluid analog picture, and it is shown that the present data require the underlying picture to be that of a fluid at its critical temperature. A comparison with p + p collision data is made. (JFP)

22536 POLARIZATION DOMAIN. Minnaert, P. (Univ., Bordeaux). pp 111-147 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The kinematical problems of describing the polarization state of particles by density matrices are discussed. Section I recalls the definitions and properties of density matrices. In Section II different metrical spaces of operators are studied and the polarization domain D_1 is defined. Section III is devoted to a study of the geometry of the polarization domain. Section IV recalls the parametrization of the density matrices by the multipole parameters $t_M^{(L)}$ and defines the real parameters $r_M^{(L)}$. In Section V the polarization domain for particles of spin $\frac{1}{2}$, 1, and $\frac{3}{2}$ is explicitly studied. (LBS)

22537 ONE LOOP RENORMALIZATION OF THE NONLINEAR SIGMA MODEL. Zinn-Justin, J. (CEN de Saclay, Gif-sur Yvette, France). pp 149-167 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

A new method is presented for regularizing and renormalizing the nonlinear σ model in the one loop approximation, which was developed recently by Bessis and Zinn-Justin (Phys. Rev. 125: 1313 (1972)). The method is based on the renormalization of the linear σ model when the σ mass or the coupling constant tends toward infinity. An explicit form is given for the pion propagator and the four pion amplitude in the nonlinear σ model even with broken symmetry. The method also assures to any order that the current algebra requirements and PCAC are satisfied. (LBS)

Electromagnetic

Refer also to abstracts 22767, 22774, 23296, and 23313.

22538 (COO-3001-44) EFFECTS OF MESONIC CURRENTS ON THE PHOTODISINTEGRATION OF THE DEUTERON AT LOW ENERGIES. Hadjimichael, E. (Sussex Univ., Brighton (England). School of Mathematical and Physical Sciences). 1973. Contract AT(11-1)-3001. 13p. Dep. NTIS $3.00.

Corrections due to mesonic currents in the reaction $d(\gamma,n)p$ at photon energies up to 22.2 MeV were calculated. Whereas the enhancement of the total and differential cross section is small, the effect is more pronounced in the polarization of outgoing protons and neutrons. (auth)

22539 (COO-3001-45) MESON EXCHANGE CURRENTS IN DEUTERON ELECTRODISINTEGRATION. Hockert, J.; Riska, D. O.; Gari, M.; Huffman, A. (State Univ. of New York, Stony Brook. Dept. of Physics). 1973. Contract AT(11-1)-3001. 27p. Dep. NTIS $3.50.

It is shown that the impulse approximation cross section for backward ed → enp at large momentum transfer near threshold is very much smaller than the empirical data. It is found that the conventional "Jankus theory" is inadequate at large momentum transfer because of the neglect of the $^3D_1$ component of the deuteron state. By taking into account the simplest meson exchange currents of pionic range the theoretical prediction of the cross section comes into reasonable agreement with the existing data. (auth)

22540 (IFVE-STF-72-27) SINGLE-PARTICLE SINGULARITIES IN QUANTUM ELECTRODYNAMICS. Pron'ko, G. P.; Solov'ev, L. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The low energy theorem is used to obtain the first two terms of the series expansion of the Compton scattering amplitude near the point of single-particle singularity to all orders in the electromagnetic interaction. (auth)

22541 (ITF-73-43-P) REGGE ASYMPTOTICS OF INCLUSIVE FORM FACTORS. Kozyrskii, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

It is shown that Regge asymptotics of inclusive form factors is determined by the behavior of the spectral JLD function in almost the whole region of its definition. (auth)

22542 (JINR-E1-7275) ON STRUCTURE FUNCTIONS OF THE DEEP INELASTIC e-p SCATTERING. Bilenkaya, S. I.; Bilenki, S. M.; Kazarinov, Yu. M.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Nuclear Problems). 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

The results of analysis of all available data on the deep inelastic e-p scattering are being presented. Various parametrizations of functions νW_2 and $R = \sigma_S/\sigma_T$ are considered. The scaling range for the function νW_2 has been investigated. The experimental data have been shown to be described well at different parametrizations of R. (auth)

22543 (JINR-E2-7283) ELECTROMAGNETIC FORM FACTOR OF THE PION. Volkov, M. K.; Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The superpropagator method is used to calculate the electromagnetic form factor of massive pion in a theory of the chiral type. The obtained values for the pion radius $\sqrt{\langle r^2 \rangle} = 0.65$ f and p, the scattering wave length ($a_1^1 = 0.031\ m_\pi^{-1}$), as well as the absolute value of the form factor in the threshold region are in good agreement with the experimental data. (auth)

22544 ABFST MODEL FOR THE INCLUSIVE REACTIONS ee → ee + X AND ee → eν + X. Skobelev, V. V. (Moscow Technical Forestry Inst.). Yadern. Fiz.; 17: No. 6, 1255-1265(Jun 1973). (In Russian).

The inclusive reactions ee → ee + X and ee → eν + X were compared in the multiperipheral model ABFST in order to calculate the helicity amplitudes of the virtual $\gamma\gamma$ forward scattering and to obtain the distribution of charged leptons from the reactions in question. The possible difference in the spectra of final leptons produced in the e^-e^- and e^+e^+ (or e^-e^+) collisions is pointed out. The obtained relation $\sigma_{TT}^{\gamma\gamma}/\sigma_{TT}^{\gamma\gamma} \to 0$ in the asymptotics of Bjorken type agrees with the preliminary experimental data. It is noted that the factorizability of the canonical ABFST model causes the helicity conservation in the S-channel for forward scattering (in the kinematical aspect). (auth)

22545 FREQUENCY SHIFT IN SCATTERING OF A PLANE WAVE BY ELECTRONS IN A STATIC MAGNETIC FIELD. Khalilov, V. R.; Kholomai, B. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 41-43(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 76-81(Jan 1973).

The methods of classical electrodynamics are used to study radiation by an electron in a magnetic field and in the field of an electromagnetic wave traveling in the direction of the magnetic field vector. If the field strength of an electromagnetic wave of finite duration (wave packet) is considered, a frequency shift for electron radiation arises which has been predicted previously. If the magnetic field is taken into account, the value of the shift may be substantially larger than the estimate obtained in [T. W. Kibble, Phys. Rev. 138, 740B, 1965]. (UDC 535.36:539.124). (auth)

22546 ALTERNATIVE WAYS OF INCLUDING AN EXTERNAL ELECTROMAGNETIC FIELD. Garczynski, W. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 4, 355-358(1973).

Two closed formulas for the wave function describing a particle

in the presence of an external electromagnetic field are given in terms of the quantum stochastic processes theory. The dependence of a Feynman path integral on the way of constructing its finite-dimensional approximations is discussed in detail. (auth)

22547 ENERGY LOSS OF A UNIFORMLY MOVING CHARGE IN A DOUBLY ANISOTROPIC MEDIUM. Datta Majumdar, S.; Sastry, G. P. (Indian Inst. of Tech., Kharagpur). Rev. Roum. Phys.; 18: No. 6, 767-773(1973).

Results obtained on the Cherenkov radiation emitted by a charge moving in the principal dielectric plane of an unbounded crystal satisfying the condition, $\epsilon_i\mu_j = \epsilon_j\mu_i$, are now extended to motion in an arbitrary direction in the crystal. As in the previous case, dispersion is taken into account and the principal axes of permittivity and permeability are assumed to be parallel to one another. By a series of transformations the integral for the radiated energy is reduced to a form which is formally identical with that for planar motion. After this reduction, the calculations and the results for the two cases become formally identical. (auth)

22548 ELASTIC SCATTERING OF WEAKLY EXCITED ELECTRONS. Khalilov, V. R. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 2, 245-247(1973). (In Russian).

Within the framework of a consideration of the loss of particles in storage rings because of elastic scattering of the particles, the incoherent scattering of the oscillator was examined with the distribution of the probability of different signs for the beam. (JSR)

22549 COMPTON SCATTERING BY L-SHELL ELECTRONS. Costescu, A.; Gavrila, M. (Univ., Bucharest). Rev. Roum. Phys.; 18: No. 4, 493-521(1973).

An analytic calculation is presented for the cross sections of the nonrelativistic Compton scattering by electrons bound in the 2s and 2p states of a hydrogen-like atom. The dipole approximation of the matrix elements is considered. The method of evaluation follows the one given previously for the case of the 1s state. The matrix elements are expressed in terms of hyper-geometric functions of two variables of Appell type F_1. Special attention is given to their behavior at the low and high energy ends of the scattered photon spectrum. Expressions are given for cross sections. In both 2s and 2p cases the angular distributions of the scattered photons are of the form $C_1 + C_2 \cos^2\theta$. A numerical computation is needed in order to evaluate the analytic results presented. (auth)

22550 OPERATOR APPROACH TO SEMI-HADRONIC INCLUSIVE REACTIONS. Brandt, R. A. (New York Univ., NY); Ng, W. C. Phys. Lett.; 45B: No. 2, 145-148(9 Jul 1973).

It is shown how operator product expansions determine the asymptotic behavior of inclusive functions in scaling variables. Such behavior is thus given in scale invariant theories by dimensional analysis. This provides a handle on the (minimal) dimensions of hadronic sources. (auth)

22551 PHOTOPRODUCTION OF W^+ MESONS FROM POSITRONS WITH ANTINEUTRINO EMISSION. Kasumzade, Yu. M.; Yakh'yaev, R. Sh. (Azerbaydzhan Teacher's Inst., Baku). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 417-419(1973). (In Russian).

A quantitative analysis was made of the reaction $\gamma + e^+ \rightarrow W^+ + \bar{\nu}_e$. A numerical evaluation of the total cross section of this process at photon energies up to 30 GeV equals 10^{-34} cm^2. The total cross section then increases almost linearly with the energy of the incident photon, beginning at approximately 8 GeV. (JSR)

22552 GENERALIZED VECTOR-MESON DOMINANCE AND HIGH ENERGY ELECTRON-PROTON INELASTIC SCATTERING. Kobayashi, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 3, 926-933(Mar 1973).

A generalized vector-meson dominance model which takes into account higher mass contributions is applied to the case of high energy electron-proton inelastic scattering. The model accounts for the scaling behavior as well as the q^2 dependence of the virtual photon-proton cross section σ_T and the longitudinal-transverse ratio R in the diffraction region. (auth)

22553 CONSTRAINTS ON LIGHT CONE EXPANSIONS DUE TO THE ASYMPTOTIC FALL-OFF OF THE ELASTIC FORM FACTORS. Sourlas, N. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys.; B59: No. 1, 34-44 (1973).

Using a technique developed by Deser, Gilbert and Sudarshan, the elastic form factors and the scaling functions are expressed in terms of the same weight functions. Sum rules for the different terms appearing in the light-cone expansion follow from the asymptotic fall-off of the elastic form factors. A set of sufficient conditions for the Drell–Yan–West relation to be valid is also written. (auth)

22554 ANOMALOUS MAGNETIC MOMENTS OF LEPTONS AND THE LAMB SHIFT IN NONLOCAL THEORY OF CURRENT–CURRENT WEAK INTERACTIONS. Efimov, G. V.; Malyshkin, V. G.; Mogilevskii, O. A.; Namsray, H.; Yumatov, A. Y. (Joint Inst. for Nuclear Research, Moscow). Nucl. Phys.; B59: No. 1, 1-22 (1973).

Calculations of corrections to the anomalous magnetic moments of leptons and the Lamb shift which are due to current weak interactions are presented. (auth)

22555 PURELY HADRONIC WEAK INTERACTIONS IN UNIFIED FIELD THEORIES OF THE WEAK AND ELECTROMAGNETIC INTERACTIONS. Bailin, D. (Univ. of Sussex, Brighton, Eng.); Love, A.; Nanopoulos, D. V.; Ross, G. G. Nucl. Phys., B59: No. 1, 177-188(1973).

Non-leptonic weak interactions are investigated in unified gauge theories. A large enhancement of parity violation in nuclei relative to conventional Cabibbo theory is indicated. (auth)

22556 SUBTRACTION CONSTANT IN $\pi^\pm$ ELECTROPRODUCTION. Devenish, R. C. E. (University Coll., London); Lyth, D. H. Nucl. Phys., B59: No. 1, 256-264(1973).

A method is proposed for dealing with the subtraction constant required in fixed-t dispersion relations for $\pi^\pm$ electroproduction. The method requires a knowledge of the t-channel cut contribution (evaluated at the subtraction points s_0), which can be determined at $k^2 = 0$ using a gauge invariance sum rule. Estimates by this and other methods show that it is small (compared with the pion pole contribution) for $-t \lesssim 1$ GeV^2, and in particular it is irrelevant to determinations of the pion form factor using high-energy forward π^+ data. (auth)

22557 SELF-CONSISTENT APPROACH TO THE FINE-STRUCTURE CONSTANT. Englert, F. (Univ. Libre, Brussels). Nuovo Cim.; 16A: No. 4, 557-572(21 Aug 1973).

Massless quantum electrodynamics is formulated as a field-theoretical "bootstrap." The resulting equations are interpreted as self-consistent equations for the physical electric charge following Adler's conjecture. The group-theoretical properties of these equations are investigated. It is shown that they are not invariant under the conformal group $O_{4,2}$ in conventional gauges, but that in other gauges a generalized "bootstrap" can be formulated which admits $O_{4,2}$ as its invariance group. The relevance of these group properties to the determination of α and to massive quantum electrodynamics is suggested. (auth)

22558 VALENCE QUARK MODEL OF MIXED SYMMETRY AND THE S-CHANNEL PICTURE OF DEEP-INELASTIC SCATTERING. Chaichian, M.; Kitakado, S. (CERN, Geneva). Nucl. Phys., B59: No. 1, 285-298(1973).

Within the quark parton model a mixed symmetry scheme for the valence component of the parton distributions is proposed. This scheme avoids the difficulty inherent in the symmetric valence quark model when applied to deep-inelastic scattering. The s-channel pattern of the resonance contributions to the structure functions is found to be ω dependent and in general different from the one observed in hadronic reactions. The polarization asymmetries near threshold are predicted to be $A_{p,n} = 1$. (auth)

22559 INTEGRAL REPRESENTATION OF THE π-MESON ELECTROMAGNETIC RADIUS. Vernov, Yu. S.; Mnatsakanova, M. N. (Inst. of Nuclear Research, Moscow). Teor. Mat. Fiz.; 16: No. 1, 66-69(Jul 1973). (In Russian).

The expression for the mean-quadratic π-meson radius in terms of rapidly convergent integrals of the form factor is obtained. (auth)

22560 BEHAVIOR OF ELECTROMAGNETIC FORM FACTORS NEAR THE LIGHT CONE. Zav'yalov, B. I. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 16: No. 1, 61-65(July 1973). (In Russian).

For the electromagnetic form factor of the nucleon, corresponding to deep inelastic electron scattering the integral condition on the spectral density is proved, which was postulated earlier. This makes it possible to get more information on the character of the singularity of the form factor near the light cone. (auth)

22561 LOW-ENERGY THEOREM FOR THE $\gamma \rightarrow 3\pi$ VERTEX AND THE $e^+e^- \rightarrow \pi^0\gamma$ PROCESS. Malakyan, Yu. P. (Physics Research Inst., Erevan). JETP Lett. (USSR) (Engl. Transl.); 17: No. 3, 118-121(5 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 3, 167-171(Feb 1973).

The experimental confirmation of the low-energy theorem $F_{3\pi} = F_\pi/ef^2$ recently established for the $\gamma \rightarrow 3\pi$ vertex is discussed. It is shown that two independent measurements of the total cross section of the process $e^+e^- \rightarrow \pi^0\gamma$ at $q^2 \sim 0.3-0.4$ GeV^2 and of the total cross section of $e^+e^- \rightarrow 3\pi$ near threshold give a perfectly defined answer for $F_{3\pi}$. (LBS)

22562 QUANTIZATION OF THE SPINOR FIELD IN SPHERICAL SPACE–TIME. Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 16: No. 1, 77-89(Jul 1973). (In Russian).

The Dirac equation in spherical space–time is solved using separation of variables. A complete countable set of the creation and annihilation operators of electrons and positrons is obtained. The operators of the most important physical quantities are constructed. (auth)

22563 PRODUCTION OF A PAIR OF POINT SPINLESS PARTICLES BY TWO PHOTONS. Zima, V. G.; Pyzh, V. M. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 5, 824-827(May 1973). (In Russian).

A tensor is calculated which describes transformation of two virtual photons to a pair of point spinless charged mesons. The results are applied to calculating the production cross section for a pair of point scalar mesons by a polarized photon on a nonpolarized target with arbitrary spin. (auth)

22564 REMARKS ON RELATIVISTIC RADIATIVE REACTION. Shen, C. S. (Purdue Univ., Lafayette, IN). Int. J. Theor. Phys.; 7: No. 4, 277-279(1973).

It is shown explicitly that the loss of kinetic energy of a highly relativistic particle in magnetic field is, in general, at the cost of both its transverse and longitudinal motion. Also, in radiation problems it is convenient and appropriate to make a Lorentz transformation into an inertial frame in which the accelerated particle is momentarily at rest. (auth)

22565 MAXIMAL LOCALIZABILITY OF PHOTONS. Jadczyk, A. Z.; Jancewicz, B. Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 5, 477-484(1973).

It is shown that simple geometric requirements lead to a unique position operator for the photon. The different components of the position do not commute. Also the problem of maximal localizability is investigated and, the conclusion is drawn that for every closed space-like curve there are exactly two independent photon states (corresponding to helicities ±1) localized on this curve. (auth)

22566 PHOTOPRODUCTION AND ELECTROPRODUCTION. Gilman, F. J. (Stanford Univ., CA). pp 277-348 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

Some of the knowledge and theoretical understanding that has been gained from the study of photoproduction and electroproduction of hadrons is discussed. The topics covered include: the electromagnetic interaction; general features of the photoproduction cross sections; photoproduction of pions at low energy—partial wave analysis; Compton scattering; vector meson photoproduction; photoproduction of charged pions at high energy; inelastic electron scattering; kinematics of inelastic electron–nucleon scattering; inelastic electron scattering experiments and scaling; the parton model; high energy behavior of the forward virtual photon–nucleon amplitude; and duality and scaling in inelastic electron scattering. (LBS)

22567 FIXED-t DISPERSION APPROACH AND SINGLE PION PHOTOPRODUCTION IN THE RESONANCE REGION. Devenish, R. C. E. (Univ. of Lancaster, Eng.); Lyth, D. H.; Rankin, W. A. Nucl. Phys.; B59: No. 1, 237-255(1973).

The hypothesis of resonance saturation of the imaginary parts of inelastic scattering amplitudes is applied to single-pion photoproduction in the resonance region using fixed-t dispersion relations. The resonance-saturated dispersion relations are evaluated for all four charge states of the reaction, making use of knowledge of resonance photonic couplings taken from multipole analyses, and the results are compared with experimental data for cross sections and polarization asymmetries in the resonance region. Forward π^+ data in the fourth resonance region are fitted and couplings for the $P_{11}(1430)$ and $F_{37}(1940)$ resonance are extracted. A new value for the $D_{15}^0(1652)$ coupling is proposed, and evidence is presented for non-zero values for at least two resonance couplings in the third resonance region, other than those of the spin-$\frac{5}{2}$ resonance. The multipoles of this calculation are compared with those from phenomenological analyses of the first resonance region. The present status of the resonance-saturated fixed-t dispersion approach is discussed. (auth)

Weak

22568 (COO-3071-26) FLUX INDEPENDENT MEASUREMENTS OF DEEP INELASTIC NEUTRINO PROCESSES. Bjorken, J. D.; Cline, D.; Mann, A. K. (Stanford Linear Accelerator Center, Calif.; Wisconsin Univ., Madison. Dept. of Physics; Pennsylvania State Univ., University Park. Dept. of Physics). 1973. 10p. Dep. NTIS $3.00.

A new scaling variable $v = xy$ is defined for the description of deep inelastic lepton-nucleon scattering processes. This variable is determined solely by the momentum and angle of the outgoing lepton. The normalized scattering distribution in this variable is independent of incident lepton energy and flux. The sensitivity to various hypothetical scale breaking mechanisms is discussed. (auth)

22569 (ITF-73-54-P) SOME FEATURES OF AUTOMODALITY. Kozyrskii, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 9p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Examples are constructed of structure functions satisfying automodality, deep inelastic Regge and threshold behavior in a simultaneous way. (auth)

22570 (ORO-3992-81) FASCINATION OF THE MUON. Sudarshan, E. C. G. (Texas Univ., Austin. Center for Particle Theory). [nd]. 5p. (CPT-135). Dep. NTIS $3.00.

Muon properties and unsolved problems are discussed. Also quantum field theory for the muon mass is considered. (JFP)

22571 (ORO-3992-136) RENORMALIZABILITY AND UNITARITY OF MASSIVE VECTOR MESON THEORIES. Hsu, J. P. (Texas Univ., Austin. Center for Particle Theory). Jun 1973. 20p. (CPT-185). Dep. NTIS $3.00.

Unitarity and renormalizability of massive vector meson theories are discussed within the general framework of the indefinite-metric field theory with canonical quantization. A model in which the massive vector meson couples to a non-conserved current is considered. It is unitary and renormalizable if the current satisfies a certain divergence condition such as partial conserved axial-vector current. Using Higgs model with the gauge condition $\partial_\mu A^\mu + \beta m\chi = 0$, it is shown that the physical state subspace cannot be defined for all times and the unitarity of the S-matrix in the physical subspace is violated. Moreover, the equation of motion for the Lagrange multiplier in the Higgs model enable one to isolate and express the extra absorptive part in the physical S-matrix of all orders in a simple and closed form. The model is unitary only after this extra part is removed from the physical S-matrix. (auth)

22572 DISPERSION SUM RULES AND VECTOR FORM FACTORS OF THE WEAK $N \rightarrow \Delta$ TRANSITION. Krive, I. V. (Kharkov State Univ.). Yadern. Fiz.; 17: No. 6, 1275-1280(Jun 1973). (In Russian).

The attempt is made to apply the superconvergent dispersion sum rules (d.s.r.) technique to the vector part of the weak current interactions with nucleons proceeding with variation of strangeness $\Delta S = 1$. When there is a saturation by the octet ($J^P = \frac{1}{2}^+$) and decuplet ($J^P = \frac{3}{2}^+$) contributions, the obtained d.s.r. completed by the SU(3) relations enables one to connect the vector constants $F_1^V(0)$ and $F_2^V(0)$ of the weak $N \rightarrow \Delta$ transition. The calculations have shown that the obtained form factors $F_{1,2}^V(0)$ are in good agreement with the predictions of the violated M(12). (auth)

22573 DECAYS OF VECTOR MESONS INTO LEPTON PAIRS AND DEVIATION FROM e-μ UNIVERSALITY. Kroide, Y. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 3, 1048-1050(Mar 1973).

It is shown that the existence of direct leptonic decays with electromagnetic interactions can give good agreement with the experimental data on $V \rightarrow l + \bar{l}$ without any contradiction to the experiments on $\eta \rightarrow \mu + \bar{\mu}$ and $K \rightarrow \mu + \bar{\mu}$. (JFP)

22574 RENORMALIZATION OF A SPONTANEOUS SYMMETRY-BREAKING MODEL IN THE UNITARY GAUGE. Ross, D. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B59: No. 1, 23-33(1973).

For the Weinberg–Salem model of leptons a comparison is made between the subtraction constants in the unitary gauge and the subtraction constants in a renormalizable gauge. It is also shown that second-order corrections in muon decay are the same in both gauges. (auth)

22575 AVERAGE INELASTICITY AND AVERAGE Q^2 IN DEEP-INELASTIC NEUTRINO–NUCLEON INTERACTIONS. Sehgal, L. M. (Technische Hochschule, Aachen). Nucl. Phys., B59: No. 1, 279-284(1973).

It is shown that under the assumptions of scaling and the Callan–Gross relation, the average inelasticity of neutrino as well as antineutrino scattering from an isoscalar nucleon target is completely determined by the ratio of the total cross sections for these reactions. Bounds are obtained on the average (momentum-transfer)^2 in terms of this ratio. Constraints applicable to scattering from proton or neutron targets are derived. (auth)

22576 MODEL OF WEAK INTERACTION BASED ON THE THREE-TRIPLET MODEL OF HADRONS. II. High-Energy Neutrino Inclusive Reactions. Tamura, S. I.; Fujii, K.

(Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 49: No. 3, 995-1006(Mar 1973).

High-energy neutrino inclusive reactions are discussed in the framework of the weak interaction model proposed in a previous paper based on the three-triplet model. Several scaling function sum rules which are different from those derived from the simple quark model in numerical values are obtained. These differences are due to the contributions from the unobserved final hadronic states which comprise super hadrons. (auth)

22577 DUAL RESONANCE MODEL AND SCALING IN QUASI-INCLUSIVE PROCESS. Roychowdhury, A.; Roychowdhury, R. K.; Banerjee, S. N. (Jadavpur Univ., Calcutta). Progr. Theor. Phys. (Kyoto); 49: No. 3, 1040-1042(Mar 1973).

22578 EIKONAL APPROXIMATION FOR DEEP INELASTIC SCATTERING IN SCALAR ELECTRODYNAMICS. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 16: No. 1, 52-60(Jul 1973). (In Russian).

The deep inelastic scattering is investigated in the model of a scalar electrodynamics with massive photons by the functional integration method in the eikonal approximation. The structure functions W_i are derived in the Björken limit. Scaling is broken by the ln ν factors. When $\nu \to \infty$, νW_2 vanishes as the square of the elastic form factor calculated in the double logarithmic approximation, and W_1 equals zero within the used accuracy. (auth)

22579 SUM RULES IN SU_4 BILOCAL ALGEBRA FOR DEEP INELASTIC SPIN-DEPENDENT νp SCATTERING. Chowdhury, A. R. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 7: No. 15, 694-696(11 Aug 1973).

Sum rules for the structure functions of deep inelastic spin-dependent neutrino-proton scattering are proposed on the basis of bilocal algebra. (JFP)

22580 SPACE-TIMES ADMITTING NONUNIQUE NEUTRINO FIELDS. Collinson, C. D.; Morris, P. B. (Univ. of Hull, Eng.). Nuovo Cim.; 16B: No. 2, 273-284(11 Aug 1973).

Those space-times admitting two distinct neutrino fields are found under the assumption that the neutrino flux vectors are geodesic and shear free. Two classes of space-times are found corresponding to neutrino flux vectors of nonzero and of zero twist. In the latter class the energy and momentum of the neutrino field vanishes. Both classes are of Petrov type D. (auth)

22581 ALGEBRAIC CLASSIFICATION OF NEUTRINO FIELDS IN GENERAL RELATIVITY. Collinson, C. D. (Univ. of Hull, Eng.). Gen. Relativity Gravitation; 4: No. 3, 211-223(Jun 1973).

An algebraic classification of neutrino fields in curved space-times is found. Several classes are simplified by assuming a positive energy density. These classes then correspond algebraically to null and nonnull electromagnetic fields. The uniqueness of the neutrino fields for these classes is discussed. (auth)

Strong (General)

Refer also to abstract 23292.

22582 (COO-2271-15) CONSTRAINTS ON POMERON COUPLINGS FROM MULTIPLE DIFFRACTIVE DISSOCIATION. Brower, R. C.; Mueller, A. H.; Sen, A.; Weis, J. H. (California Inst. of Tech., Pasadena; Columbia Univ., New York. Dept. of Physics; Washington Univ., Seattle. Dept. of Physics). 1973. 16p. Dep. NTIS $3.00.

Double diffractive dissociation proceeding through single Pomeron exchange is shown to give a contribution to the total cross section growing like ln s, if the triple-Pomeron coupling does not vanish. Similarly, the exchange of N Pomerons would lead to a $(\ln s)^N$ growth. This inconsistency of the simple Pomeron pole model of diffractive scattering is somewhat stronger than the ln ln s inconsistency previously obtained and shows: (1) nonvanishing of the triple-Pomeron coupling leads to a violation of the Froissart bound, and (2) Pomeron decouplings cannot be circumvented by Regge trajectories with $\alpha'(0) = \infty$. It is noted that multiple diffraction dissociation processes are strongly constrained by unitarity whatever the detailed nature of the Pomeron. (auth)

22583 (COO-2271-17) WHY DOES THE POMERON LOOK SO SIMPLE IF IT IS REALLY SO COMPLICATED? Finkelstein, J. (Columbia Univ., New York). 1973. 20p. Dep. NTIS $3.00.

The absorbed multiperipheral model is suggested as a vehicle for understanding the approximate constancy with energy of total cross sections that ultimately rise to saturate the Froissart bound. Two approximation schemes, which share as their lowest approximation a simple, factorizable Pomeron, are discussed. In a streamlined version of the model, an estimate of the squared energy s at which this simple picture breaks down is given by $\ln(s/s_0) = [\sigma_{tot}/(4\pi\alpha')]^{\frac{1}{2}} \cong 4.3$. (auth)

22584 (ITF-73-34-P) TWO-PHOTON PARTICLE PRODUCTION IN HADRON COLLISIONS. Zima, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

The differential cross section (in square of the invariant mass of the generated particles W^2 and in squares of the momenta resulting from the particle collision) of the two-photon particle production in hadron collisions is calculated. The asymptotics of the differential in W^2 cross section is obtained with power accuracy. The kinematics of the process is considered in detail. (auth)

22585 (JINR-E2-7276) RANDOM PROCESS APPROACH TO MULTIPARTICLE PRODUCTION AT HIGH ENERGIES. Dushutin, N. K.; Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 37p. Dep. NTIS (U.S. Sales Only) $4.00.

A review of some fundamental results obtained in models, which use an approximation of random processes for multiparticle production, is given. (auth)

22586 (ORO-3992-128) INDEPENDENT EMISSION OF NEUTRAL AND CHARGE CLUSTERS IN HIGH ENERGY HADRON COLLISIONS. Chiu, C. B.; Wang, K. H. (Texas Univ., Austin. Center for Particle Theory). Jun 1973. Contract AT(40-1)-3992. 38p. (CPT-176). Dep. NTIS $4.00.

A general formalism for the simultaneous emission of neutral and charge clusters is considered. For application, a typical two-component model based on cluster emissions is studied in detail. The diffractive component is parameterized by a $\pi\sigma$ scheme and the nondiffractive component by a πB scheme. In the nondiffractive component, the strength parameters for the emission of both π and B are found empirically to be linear in $\ln p_{Lab}$ in reminiscence of the expectation of a multiperipheral model. Furthermore, the direct pion emission is found to dominate in the low energy region (20 to 30 GeV/c), while beyond 100 GeV/c, the B emission becomes more important. This indicates that the clustering effect becomes more and more important as the energy increases. The charge multiplicity distribution and the average π^0 multiplicity at fixed π^- number, $\langle n_0 \rangle_{n_-}$ vs n_-, predicted by the model are in good agreement with the data. Asymptotically the separation of the two components becomes noticeable at around 1000 to 1500 GeV/c and the prediction for $\langle n_0 \rangle_{n_-}$ vs n_- at 1500 GeV/c is essentially the same as that at 205 GeV/c. Most features enumerated appear to be quite general properties of two component models involving the direct independent emission of pions and other clusters, insensitive to the specific πB scheme assumed. (auth)

22587 STRUCTURE OF HADRON MATTER: HIERARCHY, DEMOCRACY, OR POTENTIALITY? Kantorovich, A. (Tel Aviv Univ., Ramat, Israel). Found. Phys.; 3: No. 3, 335-349(Sep 1973).

An attempt is made to give a methodological and physical characterization to the concept of the structure of matter. The methodological status of theories describing the structure of hadrons is discussed. A parallelism is drawn between the quark model as a theory of the mathematical composite structure of hadrons and Plato's theory of matter. The merger of the bootstrap idea with a quark substructure of hadrons is discussed. A third approach to the structure of hadron matter is presented. It resembles the Aristotelian conception of primary matter on which form is imprinted potentially. (auth)

22588 EVIDENCE FOR CHANGE IN THE CHARACTERISTICS OF STRONG INTERACTIONS AT ULTRA-HIGH ENERGIES. Vatcha, R. H.; Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 6: No. 7, 1067-1077(Jul 1973).

An attempt was made to understand the experimental results on the size dependence of several properties of high energy hadrons reported previously (Vatcha and Sreekantan. J. Phys. A. Maths. Nucl. Gen.; 6: 1050-66(1973)) in terms of the characteristics of high energy collisions and primary composition using detailed Monte Carlo simulations. It is shown that the behavior of the high energy hadron component, especially the size dependence, cannot be accounted for in terms of a change of primary composition alone in the energy range 10^{14} to 10^{16} eV which has been suggested by some of the earlier investigations to explain certain properties of air showers. The present analysis strongly suggests the need for invoking rather drastic changes in the characteristics of strong interactions, at ultra-high energies. (auth)

22589 TRENDS IN THE ENERGY DEPENDENCE OF STRONG INTERACTION CHARACTERISTICS AT ULTRA-HIGH ENERGIES. Vatcha, R. H.; Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 6: No. 7, 1078-1089 (Jul 1973).

The trends in the energy dependence of strong interaction characteristics that reveal themselves when an attempt is made to bring about a closer agreement between experimentally observed size dependence of several properties of high energy hadrons in air showers and the corresponding Monte Carlo simulations, are discussed. The discussion shows the need for an increase in the inelasticity and interaction cross section of both pions and nucleons at ultra-high energies, as also an increase in the cross section for the production of nucleon-antinucleon pairs and also the need for postulating a process similar to the gammaization process of Nikolsky (Sov. Phys. JETP; 24: 535-45 (1967)) according to which a considerable fraction of energy is transferred to the soft component by-passing the normal pionization. (auth)

22590 GENERALIZATION OF MULTIPERIPHERAL MODEL WITH LONG RANGE CORRELATIONS; VAN DER WAALS APPROXIMATION. Arnold, R. C. (Argonne National Lab., IL); Steinhoff, J. Phys. Lett.; 45B: No. 2, 141-144(9 Jul 1973).

Detailed mathematical connections are shown between some reasonable models of multiple hadron production cross sections and configurational partition functions of the equilibrium theory of classical gases or liquids. This enables some well known results for the latter physical systems to be translated into asymptotic properties of the hadron production models. It is shown in particular how long-range exclusive correlations can be included. (JFP)

22591 IS KNO SCALING PROVED OR POSTULATED? Narayan, D. S. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; B59: No. 1, 299-304(1973).

Assuming Feynman's scaling law, Koba, Nielson and Olesen had shown that as $s \to \infty$, (i) $\langle n^q \rangle / \langle n \rangle^q \to d_q$ where d_q is independent of s and (ii) $\sigma_n(s)/\sigma_{incl}^{(s)} \to (1/\langle n \rangle)\psi(n/\langle n \rangle)$. The derivation of the latter result is, however, not rigorous and it does not follow, as a necessary consequence, from the scaling law. (auth)

22592 PCAC ANOMALIES AND π^0 PHOTOPRODUCTION. Casher, A.; Gomberoff, L. (Tel Aviv Univ., Israel). Nuovo Cim.; 16A: No. 4, 598-604(21 Aug 1973).

The Adler anomaly is applied to π^0 photoproduction at threshold in the framework of a quark-vector gluon model. The anomalous contributions may account for the possible discrepancy between the predicted and measured values of the M_{1+} multipoles. With a "reasonable" quark-gluon coupling constant the data favor a three-triplet-quark model (as in the case for $\pi^0 \to 2\gamma$). The range and errors of the existing theoretical analyses prevent firm conclusions from being drawn. The effect may serve as a sensitive test for the validity of the vector-gluon model. (auth)

22593 SCALING PARAMETER FOR THE MULTIPLICITY DISTRIBUTION IN HIGH ENERGY INTERACTIONS. Tati, T. (Hiroshima Univ.); Yokoyama, K. I. Progr. Theor. Phys. (Kyoto); 49: No. 3, 1058-1059(Mar 1973).

22594 POSSIBLE CONSEQUENCES OF THE QUARK MODEL FOR FRAGMENTATION PROCESSES. Lai, C. S. (Univ. of Prince Edward Island, Can.); Lo, S. Y. Aust. J. Phys.; 26: No. 3, 291-299(Jun 1973).

The quark model is used to predict various sum rules for limiting fragmentation. In particular, the radio of the cross section of $p \to p$ to that of $\pi \to \pi$ is found to be 9:4. An initial combination of the quark model with the generalized optical theorem is found to produce results which violate the quark-model selection rules and differ from experimental values by a factor of $10^2 - 10^6$. A possible modification is proposed and further tests are suggested. (auth)

22595 MODEL STUDY IN HADRON STATISTICAL BOOTSTRAP. Hagedorn, R.; Montvay, I. (CERN, Geneva). Nucl. Phys.; B59: No. 1, 45-86(1973).

In the framework of the statistical bootstrap the decay of a fireball is considered as an exact inverse of its statistical composition. This assumption leads to a bootstrap formulated in terms of integral equations for all kinds of distributions of the fireball's decay products. Solutions of the equations are obtained in terms of power series and of K-transforms and determine in the general case their asymptotic behavior for large fireball mass. Relations to a thermodynamical description are established and illustrated by effective temperatures. The approach to the asymptotic limits is easy to investigate in a simplified linear bootstrap where the K-transforms can be more explicitly calculated. (auth)

22596 EXTENSION OF A BREMSSTRAHLUNG MODEL FOR HIGH ENERGY. Soln, J. (Harry Diamond Labs., Washington, DC). Nuovo Cim.; 16A: No. 4, 624-638(21 Aug 1973).

The usual bremsstrahlung model for high-energy collisions is extended into a model that allows the secondaries to be emitted with correlations, i.e., with multiplicity distributions generally different from Poisson's. This statistical dependence of the produced secondaries is achieved by introducing the many-secondary-particle correlation amplitudes into the differential equation with respect to the coupling constant for the S-matrix. From the analysis of the elastic proton-proton differential cross section at $p_{lab} \approx$ 30 GeV/c (momentum of the incident proton in the laboratory system) and $|t|$ (square of the c.m. momentum transfer) between 5 and 20 $(GeV/c)^2$, one concludes that at least a weak two-meson correlation amplitude is needed. The same analysis also indicates that at higher momentum transfers correlation amplitudes of three, and perhaps more, mesons may be necessary in order to describe the experimental data successfully. (auth)

22597 PHENOMENOLOGY OF SCATTERING AND PRODUCTION PROCESSES AT HIGH ENERGY. Jacob, M. (CERN, Geneva). pp 349-431 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

Part I gives a rapid survey of the duality approaches to hadron physics and a discussion of a few topical questions in hadron phenomenology. Part II deals with many particle production and Regge models for production. Topics covered are: from Jacobians to dynamics; general dynamical properties; Regge approach to inclusive cross sections; deep inelastic hadron–hadron scattering; and exclusive reactions and Pomeranchuk exchange. (LBS)

22598 DUALITY IN STRONG INTERACTION PHYSICS. Fubini, S. (Massachusetts Inst. of Tech., Cambridge). pp 433-470 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

A general survey is given of the most important features of dual resonant theory. The topics discussed include: the Veneziano representation, formal properties of the Veneziano amplitude, the generalized Veneziano n point amplitude, factorization and operator formalism, dual operator formalism, projective properties of the operators, subsidiary condition and physical states, and amplitude with excited particles. (LBS)

Strong (Baryon No. = 0)

Refer also to abstract 22678.

22599 DETERMINATION OF THE $\pi\pi$ SCATTERING LENGTH α_0 FROM THE TAU-DECAY EXPERIMENTAL DATA. Bunyatov, S. A.; Gulkanyan, G. R.; Kurbatov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1307-1309 (Jun 1973). (In Russian).

The experimental data on 1.5 million of τ decays were analyzed in terms of the theory of three-particle production near threshold. The obtained value of the $\pi\pi$ scattering length $|\alpha_0| = (0.72 \pm 0.07)$ $\hbar/m_\pi c$ disagrees with Weinberg's current algebra prediction. (auth)

22600 MULTIPERIPHERAL DYNAMICS FOR THE GRAND PARTITION FUNCTION IN HIGH ENERGY COLLISIONS. Duimio, F.; Marchesini, G. (Univ., Parma, Italy). Nucl. Phys.; B59: No. 1, 222-230(1973).

The generating function connecting exclusive and inclusive integrated quantities (the grand partition function in the statistical analogy), is studied in the framework of multiperipheral dynamics: the ABFST model is used as a guide. An integral equation for this function is derived in a form in which the input is given directly by the absorptive part of the forward elastic amplitude. On the basis of simple hypotheses on the structure of this input the behavior of the integrated correlation functions is discussed in asymptotic as well as moderate energy regions. The possibility of long-range correlations, within the model, is also considered. (auth)

22601 UNITARITY AND RESONANCES OF ARBITRARILY LARGE SPIN. Rivers, R. J. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 7: No. 15, 735-741(11 Aug 1973).

It was previously shown that three diagrams with zero-width resonances in dual theory can be interpreted as containing important contributions from unitarity. It is shown that the equation for the $\eta\eta$ total cross section obtained via single s-channel resonance production is not true for an arbitrary theory in which the input resonances lie on indefinitely rising trajectories. Whether or not it is true for a dual theory depends in detail on how the input zero-width resonances become unitarized. It is shown that although arbitrary large spin does not invalidate the Breit–Wigner approximation it can invalidate the approximation in which the imaginary part of the Breit–Wigner form is replaced by a γ function. (JFP)

Strong (Baryon No. = 1)

22602 (CF-LPAM-72-11) CUSP EFFECTS IN Δ^{++} PRODUCTION IN K^+p INTERACTIONS. Benayoun, M.; Karatchent-

zeff, M.; Leruste, P.; Narjous, J. L.; Danysz, J. A.; Lewis, P. H. (College de France, Paris). 1972. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

An attempt is made to interpret theoretically a dependence of the position and shape of the Δ peak in the $p\pi^+$ mass distribution on the momentum transfer observed in the reaction $K^+p \rightarrow K^+p\pi^+\pi^-$ This interpretation is based on a near connection between the various cusp effects (depending on the momentum transfer) and the position of the $N\pi\pi$ production threshold. These effects have to be superimposed on the simple mechanism of Δ production via one pion exchange. The calculations are performed using a simplified theoretical model assuming the so-called half on the mass shell unitarity and the effective presence of the $N\pi\pi$ threshold singularity. In the model used, the classical factorization of on- and off-shell terms in amplitude is employed. T invariance and causality are postulated. (auth)

22603 (RL-73-56) MULTIPARTICLE SHADOW EFFECTS ON ELASTIC SCATTERING IN THE DUAL MODEL. Hong-Mo, C.; Paton, J. E. (Rutherford High Energy Lab., Chilton (England)). Jun 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

Unitarity effects of multiparticle channels on elastic scattering are studied schematically in the dual model. Explanations are offered for (A) the difference in energy dependence between "Pomeron" and isospin exchanges, (B) the difference in the slopes of diffraction peaks for exotic and nonexotic reactions, and (C) the "cross-over" phenomenon. (auth)

22604 TAKING INTO ACCOUNT THE TRIANGULAR SINGULARITY IN THE PARTIAL-WAVE ANALYSIS OF THE THREE-MESON SYSTEM. Kobrinskii, M. N.; Likhoded, A. K. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 6, 1310-1320(Jun 1973). (In Russian).

The isobar model is used to calculate the singular parts of the triangular graphs caused by rescattering of particles in the final state of the reactions $\pi + p \rightarrow 3\pi + p$ and $K + p \rightarrow K\pi\pi + p$. Determination of contributions from such singularities to the total cross sections of the reactions in question enables one to obtain the scattering amplitudes of non-stable particles ($\pi\pi$ or $K\pi$) at low relative energies. (auth)

22605 DISPERSION RELATIONS AND CHARGE EXCHANGE REACTION $\pi^-p \rightarrow \pi^0n$ AT HIGH ENERGIES. Solov'ev, L. D.; Shchelkachev, A. V. JETP Lett. (USSR) (Engl. Transl.); 17: No. 4, 154-155(20 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 216-218(20 Feb 1973).

It is shown that to obtain agreement with experiment it is necessary to make one subtraction in the dispersion relations for the amplitude of the charge exchange $\pi^-p \rightarrow \pi^0n$. The real part of the amplitude and $d\sigma^{ex}/dt$ tend in this case to constant values at $t = 0$ and $E \rightarrow \infty$, thus contradicting the model of complex angular momenta. (auth)

22606 NN- AND πN-INTERACTION RANGE. Stavinskii, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1300-1303(Jun 1973). (In Russian).

The slope parameter of the diffraction cone is expressed in terms of partial wave expansion. It is shown that the three quantities varying with energy—the slope parameter, the total interaction cross sections and the ratio of the real to the imaginary part of the scattering amplitude—can be described by means of some parameter which is identified with the interaction radius. (auth)

22607 πN BACKWARD SCATTERING AND THE POSSIBILITY OF EXISTENCE OF AN ELEMENTARY NUCLEON. Ginzburg, I. F.; Perlovskii, L. I. (Inst. of Mathematics, Novosibirsk, USSR). Yadern. Fiz.; 17: No. 6, 1296-1299(Jun 1973). (In Russian).

New π^-n backward-scattering data can be explained by the assumption that there exist not only the N_α-trajectory but also an elementary (non-reggeized) nucleon. The above-mentioned ideas are used to make some predictions. (auth)

22608 REGGE PARAMETRIZATION OF THE ππ-SCATTERING AMPLITUDES. Description of the Reaction $\pi^-p \rightarrow \pi^-\pi^+n$ by the OPER Model. Boreskov, K. G.; Kaidalov, A. B.; Ponomarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 6, 1285-1295(Jun 1973). (In Russian).

The reggeization of the π-meson exchange is proved to be necessary from the analysis of the data. It is shown that the one-pion-exchange reggeized model (OPER) describes well all the main characteristics of the process $\pi^-p \rightarrow \pi^-\pi^+n$ in the energy range from 2 to 30 GeV. The Regge parametrization of the ππ-scattering amplitudes is made for the two-pion masses $M_{\pi\pi} > 1.4$ GeV. (auth)

22609 MULTIPLE PRODUCTION OF CHARGED PARTICLES IN THE π^-p AND π^-n INTERACTIONS AT 40 GeV/c. Grishin, V. G.; Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Yancho, G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1281-1284(Jun 1973). (In Russian).

The model for simultaneous description of multiple production of charged particles in π^-p and π^-n interactions is presented. Comparison of the model with the 40 GeV/c data shows a good agreement. The average number a of the π^+-meson pairs produced is determined ($a = 1.81 \pm 0.02$) as well as the coefficient β of the nucleon charge exchange ($\beta = 0.36 \pm 0.04$). The distribution of events over the secondary charged particles is predicted to be the same for e.g., π^+p and π^-p, pp and $p\bar{p}$ collisions. (auth)

22610 $\pi^-p \rightarrow n\,l^+l^-$ PROCESS NEAR THE Δ(1236) RESONANCE. Smirnov, G. I.; Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1266-1274(Jun 1973). (In Russian).

The process $\pi^-p \rightarrow nl^+l^-$ near Δ(1236) resonance is treated using the isobaric model. It is shown that the isobar term gives small contribution to the cross section. The sensitivity of the cross sections to the electromagnetic structure of pion and nucleon is investigated. The results of calculation are compared with the experimental data. (auth)

22611 MULTIPLE-PARTICLE PRODUCTION IN THE STRAIGHT-LINE PATH APPROXIMATION. Kuleshov, S. P. (Joint Inst. for Nuclear Research, Dubna, USSR); Matveev, V. A.; Sissakian A. N. Fizika (Zagreb); 5: No. 2, 67-76(May 1973).

Some results of the investigation of processes of multiple production in the framework of field-theory models, using the Feynman–Bogolubov functional integral method, are given. By the use of the straight-line path approximation it is shown that the N meson production amplitude is factorized and a multiplicity distribution of the Poisson type is obtained. An interesting relation between the multiplicity of secondary particles, the slope of the diffractional peak, and the total cross section is obtained. By a simple assumption about the isospin structure the model is used to fit the charged particle multiplicity distribution for both π^-p and π^-n scattering at 40 GeV. (auth)

22612 OVERLAPPING ISOSPIN-DEPENDENT INTERACTIONS IN HIGH-ENERGY PION–DEUTERON SCATTERING. Harrington, D. R. (Rutgers–The State Univ., New Brunswick, NJ). Nucl. Phys.; B59: No. 1, 305-323(1973).

The complications introduced into Glauber theory by overlapping isospin-dependent interactions are discussed in the context of high-energy pion-deuteron scattering. The commonly used ordered form of the Glauber theory is exact only when the isospin-dependent potentials have zero overlap, or in the limit in which they are weak. A pair of coupled integral equations is derived which should be useful for numerical calculations when the ordered form is inadequate. An exactly soluble one-dimensional overlapping slab model is also discussed; it gives some idea of the nature of the approximation made when the ordered form is used. Finally, an overlap expansion is developed for another one-dimensional model in which the potentials have more realistic exponential tails. Such expansions could be useful for estimating the magnitudes of the errors introduced through the use of the ordered form. (auth)

22613 DYNAMICS OF THE REACTION $KN \rightarrow K^*N$ FROM K_LN INTERACTIONS. Dass, G. V. (Deutsches Elektronen Synchrotron, Hamburg). Nucl. Phys., B59: No. 1, 324-332(1973).

If $K^*_{S,L}$ is a K* resonance decaying into $K_{S,L}$ (the short- and long-lived kaon) and a neutral system S^0 of pions, one can isolate the C-even and C-odd, crossed-channel contributions to $KN \rightarrow K^*N$ by using the reactions $K_LN \rightarrow K^*_{S,L}N$ whether S^0 is a C-eigenstate, or a mixture of C-even and C-odd states. Applications to the production of K*(890) and the Q-meson are discussed, and simple numerical predictions made for $Q_{S,L}$ production. Q-production data indicate approximate t-channel helicity conservation for the ω and P′ exchanges at vertices involving a spin change, in similarity to the belief for the pomeron. $Q_{S,L}$ production data can give information also on Q-decays. (auth)

22614 INCLUSIVE REACTIONS: A NEW PARAMETRIZATION. Biswas, N. N.; Cason, N. M.; Kenney, V. P.; Powers, J. T.; Shephard, W. D. (Univ. of Notre Dame, IN). Nucl. Phys., B59: No. 1, 273-278(1973).

The π^- spectra from the reactions $\pi^\pm p \rightarrow \pi^- +$ anything were fitted using an expression which exhibits the differing forward-backward slopes of the x-distributions, the turnover near (but not exactly at) $x = 0$ and the correlations between $P_\parallel$ and $p_\perp^2$. The expression is a generalized Bose–Einstein distribution which is covariant with respect to Lorentz transformations along the incident beam direction. (auth)

22615 GEOMETRIC SCALING, MULTIPLICITY DISTRIBUTIONS, AND CROSS SECTIONS. Dias de Deus, J. (Univ. of Copenhagen). Nucl. Phys.; B59: No. 1, 231-236(1973).

From a geometric picture of hadrons as extended objects some universal features of high energy collisions are obtained. In this approach the mean multiplicity, as a function of s, and the KNO scaling function are universal, and asymptotically the ratio $\sigma_{elastic}/\sigma_{total}$ is expected to be the same for all processes. (auth)

22616 DETERMINATIONS ON THE KN EFFECTIVE COUPLING CONSTANT FROM FORWARD AMPLITUDES. Sznajder Hald, N. (NORDITA, Copenhagen); Petersen, J. L.; Nenciu, G. Nucl. Phys., B59: No. 1, 93-105(1973).

The problem of extracting the effective KNY coupling constant from data on KN forward amplitudes is discussed in a general way. In particular the impact of the so called positivity condition recently claimed by Lopez and Yndurain to give a coupling constant determination with errors comparable to those on $G^2_{\pi NN}/4\pi$ is investigated. Possible biases in their estimate are pointed out, an approximation scheme related to the Padé approximation scheme free of these is devised and an analysis is performed using it. By explicit construction it is shown that positivity still allows a large range of coupling constants. (auth)

22617 MASS AND WIDTH OF A BROAD RESONANCE. Lichtenberg, D. B. (Indiana Univ., Bloomington). Contract AT(11-1)-2009. Lett. Nuovo Cim.; 7: No. 15, 727-731(11 Aug 1973).

A phenomenological scheme for parametrizing a resonant amplitude in the presence of background is presented for meson–nucleon elastic scattering at cms energies below 3 GeV. The mass and width of the $\Delta(1236)$ are found. (JFP)

22618 PARTON MODEL AND MULTIPLE SCATTERING IN HIGH ENERGY $\pi^{\pm}$p ELASTIC SCATTERING. Keinanen, J. K.; Raychaudhuri, P. (Univ. of Oulu, Finland). Lett. Nuovo Cim.; 7: No. 15, 765-771(11 Aug 1973).

The effects of multiple scattering in $\pi^+ + p$ and $\pi^- + p$ elastic scattering in the high energy limit are investigated using two different approaches to the scattering problem, e.g. Chou-Yang and Glauber methods. For this one must know in the case of the Chou-Yang model the pion and proton form factors, but in the case of Glauber's method one needs according to the parton model the pion–pion scattering amplitude and the proton form factor. The differential cross sections are calculated up to $t = 6$ (GeV/c)^2. (JFP)

22619 INCLUSIVE ANTINEUTRINO–NUCLEON SCATTERING AS PROBING THE NUCLEON CORE. Rein, D.; Rodenberg, R. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 7: No. 15, 742-744(11 Aug 1973).

The importance of deep inelastic antineutrino–nucleon scattering for studying the core structure of the nucleon is emphasized. The double differential cross sections for neutrino (antineutrino)–nucleon scattering in the scaling limit are considered in the Feynman parton model. The total cross sections are found. The assumption on the smallness of the average core particle momentum can be justified. (JFP)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 22522, 22761, 22763, 22765, 22819, 22908, and 23129.

22620 (COO-881-361) TRACING PARTONS IN HADRON COLLISIONS AT HIGH TRANSVERSE MOMENTUM. Halzen, F. (Wisconsin Univ., Madison. Dept. of Physics). Apr 1973. Contract AT(11-1)-881. 28p. (CONF-730334-6). Dep. NTIS $3.50.

From eighth Recontre de Moriond conference; Meribel-les Allues, France (4 Mar 1973).

Hadron collisions at large transverse momentum are discussed. They probe the hadrons at small distances; from this point of view the phenomenological analysis of two body reactions at large angles and single particle inclusive reactions at large p_T jets of large transverse momentum hadrons are discussed. (auth)

22621 (FRNC-R-20, pp II.37-II.85) DISTRIBUTIONS ON MINKOWSKI SPACE AND THEIR CONNECTION WITH ANALYTIC REPRESENTATIONS OF THE CONFORMAL GROUP. Ruehl, W. (Univ., Kaiserslautern, Ger.). Mar 1972.

Unitary analytic representations of the conformal group are realized in Hilbert spaces of holomorphic or antiholomorphic functions over a tube domain in complex Minkowski space. The distributional boundary values of these functions are tempered distributions in real Minkowski space. The representations are characterized by an integral scale dimension label n and two spin labels j_1 and j_2. The connection between the dimension n and the degree of singularity of the tempered distribution is investigated. An application to inclusive reactions between elementary particles is proposed. (auth)

22622 (IFVE-STF-72-76) INTERACTION OF HIGH ENERGY PARTICLES WITH DEUTERON AND SEMIPHENOMENOLOGICAL FORMULAE FOR THE GLAUBER CORRECTIONS. Anisovich, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The shadow corrections for the total cross sections on a deuteron are discussed taking into account the inelastic rescattering effects. The expressions with one phenomenological parameter are given for these shadow corrections. (auth)

22623 (ITF-73-14-P) ELASTIC SCATTERING OF π-MESONS BY DEUTERONS. Petrov, N. M.; Peresypkin, V. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

On the basis of Faddeev integral equations the problem of elastic scattering of π-mesons by deuteron is considered. Interaction between the nucleons is described by the potential with the separable variables and the pion-nucleon t-matrix is approximated by the constant. The scattering length is calculated in the assumption that the interaction between particles takes place only at S-state. The dependence of π-d scattering length in the form of a two-nucleon potential is studied. (auth)

22624 (JUL-924-KP) CALCULATION OF OSCILLATOR MATRIX ELEMENTS OF THE NUCLEON–NUCLEON INTERACTION DIRECTLY FROM THE PHASE SHIFTS. Sommer, B. (Kernforschungsanlage, Juelich (West Germany) Institut fuer Kernphysik). Feb 1973. 87p. (In German). Dep. NTIS (U.S. Sales Only) $6.50.

A method is presented how to calculate oscillator matrix elements of the nucleon-nucleon interaction directly from the phase shifts. Any soft core potential which may contain a tensor operator can be used as zero order potential. Matrix elements are calculated in Born approximation. These are tested in Hartree–Fock-calculations of ^{12}C, ^{16}O, and ^{20}Ne. (auth)

22625 (RL-73-65) PRONG CROSS-SECTIONS FROM A REALISTIC TWO-COMPONENT MODEL. Roberts, R. G.; Roy, D. P. (Rutherford High Energy Lab., Chilton (England)). Jul 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The inclusive pp → pX data, supporting a large triple Pomeron contribution, is invoked to predict the diffractive multiplicity distributions. Poisson decay is assumed for the excited cluster. The predicted diffractive prong cross-sections agree with the empirical estimates at 200 GeV/c and suggest a significant broadening at 1500 GeV/c (giving a rise in $\sigma_T \sim 2.5$ mb). Consequently the full prong distribution should develop no dip. (auth)

22626 SCATTERING OF HIGH ENERGY PARTICLES BY NUCLEI AND THE EFFECTIVE OPTICAL POTENTIAL. Petkov, I. Zh. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 481-497(1971). (In Russian).

The theory of the optical potential and the methods of solving the problem of high energy scattering of particles on nuclei are presented in succession. (auth)

22627 THEORETICAL APPROACH TO THE ELASTIC pd-SCATTERING AT LARGE ANGLES. Kolybasov, V. M.; Smorodinskaya, N. Ya. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 6, 1211-1221(Jun 1973). (In Russian).

One of possible mechanisms of the elastic pd-scattering at large angles in the resonance energy region is studied theoretically. The two-step process is considered when the virtual reaction $p + p \rightarrow d + \pi^+$ is followed by absorption of the produced pion by the second nucleon. Such mechanism leads to the resonant energy behavior of the cross section at energies near 600 MeV. The D-state admixture is taken into account and the corrections due to the "relativism" of the corresponding Feynman graph are estimated. Other possible mechanisms are approximately taken into account by adding a background showing no resonant peak. The calculation results are in satisfactory agreement with the available experimental data. (auth)

22628 REAL PART OF SPINLESS pp-SCATTERING AMPLITUDE AT ZERO ANGLE IN THE ENERGY REGION FROM 0.135 TO 1.700 GeV/c. Amirkhanov, I. V.; Bystritskii, V. M.; Vertogradov, L. S.; Zul'karneev, R. Ya.; Kutuev, R. Kh.; Murtazaev, Kh.; Nadezhdin, V. S.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1222-1223(Jun 1973). (In Russian).

The values of the real part of spinless pp forward scattering amplitude are presented for a wide energy range from 9.7 to 970.0

MeV. The preliminary results of measuring $d\sigma_{pp}/d\Omega$ at 500, 630, and 670 MeV are also reported as well as the corresponding new values of Re A(0) at the same energies. (auth)

22629 COULOMB CORRECTIONS TO THE pp-SCATTERING PARAMETERS AND THE p^2 DEPENDENCE OF NUCLEAR INTERACTION. Kumpf, G. (Central Inst. for Nuclear Research, Rossendorf, Ger.). Yadern. Fiz.; 17: No. 6, 1156-1160(Jun 1973). (In Russian).

The effect of the p^2-dependence of NN-interaction of the value of Coulomb correction to the pp-scattering length and scattering phases is studied. (auth)

22630 PION-DEUTERON SCATTERING AT THE ENERGIES CLOSE TO THE Δ RESONANCE AND THE ISOBAR-NUCLEON INTERACTION. Karmanov, V. A. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 17: No. 6, 1203-1210(Jun 1973). (In Russian).

The three-body problem (pion-deuteron scattering at the energies close to the Δ resonance) is reduced to the two-body problem of the Δ-isobar scattering by a nucleon. The analytical expression for the ΔN scattering amplitude is obtained and the πd-scattering cross section near the resonance is calculated taking into account the spins of the particles. Quantitative estimations which are in good agreement with the experimental data show that the pion higher order rescatterings are of great importance in the large-angle scattering. (auth)

22631 BARYON RESONANCES OF THE QUASI-NUCLEAR TYPE. Dal'karov, O. D.; Kerbikov, B. O.; Rumyantsev, I. A.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 6, 1321-1329(Jun 1973). (In Russian).

It is shown that there must be narrow nonrelativistic bound states of the quasi-nuclear type in the system involving two nucleons and one antinucleon. The mass spectrum and the spectrum of the annihilation widths are calculated. (auth)

22632 REMARKS ON THE REGGE-LIKE BEHAVIOUR OF THE ONE-BOSON-EXCHANGE AMPLITUDE IN LOW-ENERGY NUCLEON-NUCLEON SCATTERING. K-Matrix Method. Susuki, Y. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 541-551(Feb 1973).

For the nucleon-nucleon scattering amplitudes at low energies, Regge-like behavior is studied using the K-matrix unitarization method. The Regge-like behavior is phenomenologically represented by the energy dependence of the coupling constant and mass of the exchanged boson in the one-boson-exchange (OBE) amplitudes. This behavior is shown to be likely for the vector-meson-exchange part. It is consistent with the results of an earlier analysis in terms of the partial wave dispersion relation. For the scalar meson, however, no strong evidence is found for such a behavior and its behavior is not inconsistent with a cut or fixed pole. (auth)

22633 DIFFRACTION DISSOCIATION INTO HIGH MASSES AT NAL-ISR ENERGIES. Frazer, W. R. (Univ. of California, San Diego, La Jolla); Snider, D. R. Phys. Lett.; 45B: No. 2, 136-140 (9 Jul 1973).

The triple-pomeron picture of diffraction dissociation into high masses, combined with recent observations about the dominance of short-range correlations in multiparticle production at very high energies, implies that the cross section for diffractive dissociation into high masses rises approximately logarithmically in the NAL-ISR energy range. Predictions are also made about the multiplicity distribution of diffractively-produced particles. (auth)

22634 DIFFRACTION DISSOCIATION MULTIPLICITY DISTRIBUTION. Kajantie, K. (Helsinki Univ.); Ruuskanen, P. V. Phys. Lett.; 45B: No. 2, 149-153(9 Jul 1973).

A model for diffractive events in high energy hadron collisions is constructed and the charged particle multiplicity distribution following from this is calculated. The model is a nova-type model in which the excitation spectrum of the nova behaves like M^{-2} for large M and in which the nova decays longitudinally in its rest frame. These features are motivated by simple multiperipheral arguments. Implications of the results on multiperipheral and uncorrected jet model descriptions of the pionization component are discussed. (auth)

22635 SEMIPHENOMENOLOGICAL FORMULA FOR THE SHADOW CORRECTIONS TO THE INTERACTIONS OF HIGH-ENERGY PARTICLES WITH A DEUTERON. Anisovich, V. V. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 6, 1304-1306(Jun 1973). (In Russian).

The shadow corrections to the total cross section of reactions with a deuteron are discussed taking into account the inelastic screening. The expressions involving a phenomenological parameter are given for the above-mentioned shadow corrections. (auth)

22636 ΣΛ CONVERSION IN ${}^3_\Lambda$H AND IN OTHER S-SHELL HYPERNUCLEI. Dabrowski, J. (Inst. for Nuclear Research, Warsaw); Fedorynska, E. Nucl. Phys.; A210: No. 3, 509-530(1973).

The binding energy of the Λ particle in the $J = 1/2$ and $3/2$ states of ${}^3_\Lambda$H and the doublet and quartet Λ-d scattering lengths are calculated with a separable ΛN-ΣN potential matrix, fitted to experimental data in ΛN and ΣN channels. The dependence of the results on ΛΣ coupling is explained in terms of a perturbative treatment of ΛΣ coupling. This perturbative treatment is also applied in a qualitative discussion of the effects of ΛΣ conversion in the $J = 0$ and 1 states of ${}^4_\Lambda$H-${}^4_\Lambda$He and in the $J = 1/2$ state of ${}^3_\Lambda$He. The importance of three-body ΛNN forces caused by ΣΛ coupling is stressed. (3 figures, 2 tables) (auth)

22637 SLOPE OF CONE IN pp SCATTERING AND THE QUASIPOLE MODEL. Tsarev, V. A. (Lebeded Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 17: No. 3, 121-124(5 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 3, 171-174(5 Feb 1973).

Recent measurements of the cross sections for pp scattering in the CERN colliding beams at $S \sim 500$ to 3000 GeV^2 and their comparison with data revealed two important circumstances: (a) the diffraction-cone slope parameter b decreases by ~1.5 GeV^{-2} on going from the region of small $|t| \lesssim 0.15$ GeV^2 to the region of large $|t| > 0.15$ GeV^2. (b) b is not a strictly linear function of ln s and varies more slowly. It is shown that the foregoing pecularities of the diffraction-cone slope parameter can be explained by the previously proposed quasipole mode. (LBS)

22638 SINGLE MUON SPECTRA IN THE PROCESSES $p + N \rightarrow \mu^+ + \mu^-$ + (HADRONS) AND $W(\rightarrow \mu + \nu)$ + (HADRONS) WITHIN THE FRAMEWORK OF THE PARTON MODEL. Golubkov, Yu. A. (Moscow Engineering Physics Inst.); Ivanilov, A. A.; Nikitin, Yu. P.; Rozhnov, R. V. JETP Lett. (USSR) (Engl. Transl.); 17: No. 3, 110-112(5 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 3, 158-160(5 Feb 1973).

The muon spectra for the processes $p + N \rightarrow W^\pm$ + hadrons, $W^\pm \rightarrow \mu^\pm + \nu$ and $p + N \rightarrow \mu^+ + \mu^-$ + hadrons are calculated within the framework of the quark parton model. (LBS)

22639 POSSIBLE BEHAVIOR OF THE TOTAL CROSS SECTION FOR PROTON-PROTON INTERACTION BETWEEN 1 AND 10^{10} GeV. Capdevielle, J. N. (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France); Cachon, A.; Dupuy, J. Compt. Rend., Ser. A, B; 276: No. 23, 875-878(4 Jun 1973). (In French).

Analysis of the average properties of extensive cosmic air showers enabled the total cross section to be evaluated between 10^5 and 10^{10} GeV. The value obtained is 280 ± 20 mb, a value which appears to be invariable in the interval considered, and even consistent with values obtained for energies up to 10^{12} GeV. This value corresponds to an asymptotic value of 46.8 mb for proton targets which is reached at less than 10^5 GeV at the expense of an increase in cross section. This result is in agreement with results obtained recently using accelerators. (FR)

22640 FRAGMENTATION MODELS AND UNITARITY. Teper, M. (Westfield Coll., London). Nucl. Phys.; B59: No. 1, 166-176(1973).

The diffractive excitation model is used to evaluate the inelastic part of the proton-proton unitarity equation. Conventional assumptions about the phase of the vacuum singularity, and an experimentally motivated choice of mass dependence for the diffractive slope, lead to an upper bound for the proportion of diffractively excited inelastic processes. The apparent breakdown of factorization is also discussed. (auth)

22641 AUTOMODELLISM IN THE LARGE-ANGLE ELASTIC SCATTERING AND STRUCTURE OF HADRONS. Matveev, V. A.; Muradyan, R. M.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Moscow). Lett. Nuovo Cim.; 7: No. 15, 719-723 (11 Aug 1973).

The possibility is pointed out of revealing a local or pointlike structure of hadrons in pure hadronic reactions of elastic scattering at large momentum transfers. In the framework of the quark model by using the principle of automodellism it is shown that in the limit $-t, s \rightarrow \infty$ at t/s fixed the given automodel asymptotic relations for the differential cross sections of elastic p + p, π + p, π + π, e + p, e + π, and e + e scattering hold. (JFP)

22642 MASS INTERFERENCE PATTERNS IN DIFFRACTIVE DISSOCIATION OF HADRONS. Chavda, L. K. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 7: No. 15, 713-718(11 Aug 1973).

The restrictions on the diffractionlike interference patterns of the mass distribution of mutually interacting systems in the Van Hove continuum model are discussed. The coherent cross sections for a high energy pion colliding with a nucleus are found. It is shown that the prediction of the diffraction pattern in the mass

distribution is merely a test of the multichannel Schroedinger equation at high energies. (JFP)

22643 RISING CROSS SECTION AND THE REAL PART OF THE FORWARD AMPLITUDE IN PROTON–PROTON SCATTERING. Kroll, P. (Univ., Karlsruhe, Ger.). Lett. Nuovo Cim.; 7: No. 15, 745-749(11 Aug 1973).

The consequences of the different behavior of the rising total cross sections for p + p scattering are discussed. The real part of the forward amplitude which can be calculated from the total cross section using dispersion relations is considered. (JFP)

22644 HIGH ENERGY SMALL-ANGLE p–p ELASTIC SCATTERING AND SPATIAL EXTENSION OF THE PION CLOUD IN THE HADRONIC-MATTER DISTRIBUTION OF THE PROTON. Misra, R. C. (Univ. of Nigeria, Nsukka). Lett. Nuovo Cim.; 7: No. 15, 732-734(11 Aug 1973).

The hadronic form factor for a phenomenological optical potential for small t is computed. The differential cross section is calculated by using the Chou-Yang model, and an estimate of β = 0.6 fm is given for the pion cloud at the ISR energy 2820 GeV^2. The value of β is seen to be increasing as the energy is increased, although the rate of increase is very slow. The effective radius of the p + p interaction is estimated as 2β. (JFP)

22645 STUDY OF THE NEUTRON–NEUTRON INTERACTION FROM THE n + d BREAK-UP PROCESS. Bouchez, R. (Institut des Sciences Nucleaires, Grenoble, France). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 151-165(1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

The results of the deuteron break-up d(n,nn) by 14 MeV neutrons, which show an n–n interaction in the final state, are analyzed with the object of obtaining the n–n interaction parameters which cannot be obtained directly. The energy spectrum of the forward going protons in the incomplete experiments cannot easily give the scattering length a_{nn}, for it is difficult to separate the effects of a_{nn} and of the two-body N–N potential. When the FADDEEV theory is not used, the incomplete experiments with three nucleons do not represent measurements of a_{nn}, but must be considered as tests of final-state interaction theories, using $a_{nn} \approx -17$ fm as a parameter. By contrast, the shape of the n–n final state interaction peak in the complete experiments ought to give a_{nn} more easily. The exact solution of the FADDEEV equations gives a shape which differs little (≈10% at $E_{nn} \approx 1$ MeV) from that given by the simple MIGDAL–WATSON relation, and which varies then little with the two-body N–N interaction. The values $a_{nn} \approx -17$ fm obtained at Hamburg (M – W relation and without correction for momentum transfer dependence), and $|a_{nn}| \geq 20$ fm obtained at Grenoble (exact FADDEEV calculations, but with the YAMAGUCHI N – N potential) do not represent an important disagreement. Finally, the magnitude of the n – n peak in the complete experiments depends noticeably on the choice of the N–N potential; the separable N–N potential of YAMAGUCHI chosen for the exact calculations with the FADDEEV equations gives about two times measured value at Grenoble. The precise measurement of the magnitude of the n–n peak together with a better choice of the two-nucleon potential (hard core, tensor forces) for the solution of the FADDEEV equations, now seems necessary. (auth)

22646 FINAL STATE INTERACTIONS. McKee, J. S. C. (Univ. of Birmingham, Eng.). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 167-189(1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

General aspects of the final state interactions and the main features of the Watson–Migdal theory are discussed. The reactions ^{7}Li + d → n + α + α, d + d → d + p + n and N + N → d + π + π are analyzed as special examples of three body final states. (auth)

22647 BACKWARD p–d SCATTERING IN THE GeV REGION. Mitra, A. N. (Univ. of Delhi). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 233-242(1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

The backward p–d scattering is studied. In the GeV region in addition to the simple N-exchange quite a lot of I = ½ N-exchanges are expected. Though each separate N-contribution to the pd → dp process is small, the existence of a fairly large number of such N states produces a sufficiently large constructive interference of the individual resonance contributions. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 22621, 23106, 23306, and 23335.

22648 (FRNC-R-20) COLLOQUIUM ON GROUP THEORETICAL METHODS IN PHYSICS, MARSEILLES: FRANCE, JUNE 5–9, 1972. (Aix-Marseilles Univ. (France); Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). 1972. 287p. (CONF-720685-).

Nineteen papers were presented at the conference. They discuss: the relation between classical and quantum mechanics, the search for unitary representations of Lie groups; the groups involved in the study of crystals in magnetic fields; cohomology (quantization, particles in external fields, quantum electrodynamics); double cosets, group deformations, and C-algebra. Separate abstracts for nine papers were prepared. (auth)

For abstracts of individual papers see: 22407, 22526, 22621, 22649–22652, 23290, and 23306.

22649 (FRNC-R-20, pp I.11-I.26) MAXIMAL KINEMATICAL INVARIANCE GROUP OF THE FREE SCHROEDINGER EQUATION. Niederer, U. (Univ., Zurich). Mar 1972.

The largest group of space-time transformations which leave invariant the free Schroedinger equation is found to be a 12-parameter Lie group containing the Galilei group, the dilations and a group of rational transformations. The group is discussed, and it is shown that the Schroedinger functions carry a unitary irreducible projective representation. (auth)

22650 (FRNC-R-20, pp I.27-I.46) APPLICATIONS OF THE SYMMETRIC GROUP. Kramer, P. (Univ., Tuebingen, Ger.). 1972.

Recent applications of the symmetry group S(n) to fermions systems (in particular nucleons) were considered. The methods presented are appropriate to systems of fermions constructed from subsystems. These subsystems can be: either several occupied shells in a mixed shell configuration, or occupied sets of atomic orbits in a molecule or two colliding nuclei in a nuclear reaction. (auth)

22651 (FRNC-R-20, pp II.1-II.6) GENERAL COVARIANT WAVE FUNCTIONS FOR MASSIVE FIELDS. Niederer, U. H. (Univ., Zurich); O'Raifeartaigh, L. 1972.

A single irreducible representation of the Poincare group (of positive mass m) can be described by many different finite-component covariant wave functions. It is shown how all such wave functions corresponding to such a single irreducible representation of the Poincare group can be characterized. (auth)

22652 (FRNC-R-20, pp II.7-II.35) GAUGE GROUP AND EXTENSIONS OF POINCARE GROUP. Rideau, G. (Univ., Paris). 1972.

In order to unify in a single invariant group of the quantum electrodynamics, the Poincare group and the gauge group, the continuous extensions of the Poincare group by the gauge group, seen as the additive group of an Hilbert space where is realized the representation of mass zero and spin zero of the Poincare group, where studied. It is shown that the only possible extension is the inessential extension. (auth)

22653 MATRIX ELEMENTS OF THE PERMUTATION GROUP IN THE HYPERSPHERICAL FORMALISM. Raynal, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 45B: No. 2, 89-92 (9 Jul 1973).

A symmetric expression of the matrix elements of the permutation group defined by Kildyushov is derived. A three terms recurrence relation is also given. (auth)

22654 CONSTRUCTION OF THE SU(2) ⊗ L↑ INVARIANT NONLINEAR SPINOR EQUATION. Smirnov, A. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 2, 230-233(1973). (In Russian).

On an example of SU(2) groups, the applicability of the nonlinear group representation method to the establishment of the form of the nonlinear self-action term in spinor equations was investigated. The nonlinear representation of the SU(2) groups was introduced into the space of the spinor of the orthochronous Lorentz group L↑. Two existing nonlinear SU(2) group representations were found in two-dimension intrinsic space of the spinors of the L↑ group. The nonlinear SU(2) group representation found was prepared in terms of the covariant derivatives of the spinor field, corresponding to the nonlinear spinor equations. The principal applicability of the nonlinear representation group method for establishment of the form of the nonlinear self-action term in the spinor equation was demonstrated. Possible uses of the results obtained were discussed. (tr-auth)

22655 SOLUTIONS OF THE DIRAC EQUATION IN INFINITE DE SITTER SPACE (REPRESENTATIONS OF $SO_{3,2}$). Riordan, F. (Birmingham Univ., Eng.). Nuovo Cim.; 16A: No. 4, 529-546 (21 Aug 1973).

All the solutions of the Dirac equation in the infinite-space de Sitter universe are found and it is shown that they form a basis

for a representation of the group of motions for this universe $SO_{3,2}$. The action of the generators of $SO_{3,2}$ on these solutions is explicitly given as a linear superposition of solutions. A mass formula is also derived. (auth)

22656 CPT-INVARIANCE IN THE THEORY OF LOCAL OBSERVABLES. Zinov'ev, Yu. M. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 16: No. 1, 21-32(Jul 1973). (In Russian)

Sufficient conditions for the existence of the CPT-operator in the Haag–Araki theory are obtained. Generalized versions of classical theorems connected with the existence of the CPT-operator are proved. (auth)

22657 RELATIVISTIC DESCRIPTION OF PARTICLES WITH SPIN. Moussa, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 81-109 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

In the first part of these lectures elementary methods are used to describe the representations of the Poincare group. Two Casimir operators of the Poincare group are introduced, which are used to classify the representations by means of two quantum numbers, mass and spin. Parity and time reversal are entered without changing the preceding classification. Spinorial amplitudes are introduced. The second part of these lectures is devoted to the construction of free fields. The quantized field is introduced directly as a local operator in Fock space. Only detailed properties imposed by the local character of fields are emphasized: relative parity of the particle-antiparticle system with respect to the vacuum, connection between spin and statistics, and the conditions under which a particle multiplet of an internal symmetry group is its own antimultiplet. (LBS)

Applications (Electromagnetic and Weak)

22658 (DNPL/R-27) THEORETICAL APPROACHES TO K_{l3} DECAY. Daresbury Lecture Note Series No. 10. Notes Based on a Lecture Given at Daresbury Nuclear Physics Laboratory, 30th October 1972. Paver, N. (Daresbury Nuclear Physics Lab. (England)). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

A discussion on K_{l3} decay is given, in the framework of SU(3) × SU(3) equal time and light cone commutation relations. (auth)

22659 UNITARITY AND INVARIANCE IN THE STUDY OF CP VIOLATION. Chela-Flores, J. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Acta Cient. Venez.; 22: 123 (1972). (In Spanish).

By extending the parametrization of CP violating amplitudes the anomalous two pionic modes of decay of the long-lived kaon as well as the neutral three pionic mode of decay of the short-lived kaon are studied. While the formalism allows the modulus and phase of the η_{00} parameter to be determined a small violation of the $\Delta S = \Delta Q$ selection rule is also found and a nonvanishing value for the CP violating neutral mode K_1 assuming the absence of the charged mode is inferred. (auth)

22660 PARTICLE-LIKE REPRESENTATIONS OF THE COMPLETE HOMOGENEOUS LORENTZ GROUP. De Wet, J. A. Proc. Cambridge Phil. Soc.; 74: No. 1, 149-160(Jul 1973).

In two previous papers (de Wet, Proc. Cambridge Philos. Soc.; 70: 485(1971), and 72: 123(1972)) representations of the unitary groups U_4, U_2 were found which described some of the properties of nucleons and electrons. In particular, the many electron wave functions were constructed from the irreducible representations of U_2 restricted to the proper orthochronous Lorentz group L_p. The irreducible representations of U_4 found in the first paper will be shown to be also irreducible representations of the complete homogeneous Lorentz group L_0, and the techniques of matrix contraction employed in the second paper will be used to find the precise form of the matrices of the infinitesimal ring. (auth)

22661 NONLEPTONIC $\Delta I = 1/2$ RULE IN THE CHIRAL CURRENT-MIXING GAUGE THEORIES. Yu, L. P. (Univ. of California, San Diego, La Jolla). Lett. Nuovo Cim.; 7: No. 15, 779-783(11 Aug 1973).

Lee and Treiman recently observed that the nonleptonic $\Delta I = 1/2$ rule can be realized through the Higgs-boson exchange in the eight-quark version of the Georgi–Glashow model, provided one is free to adjust the mass parameter of the Higgs boson and is willing to assume that as a result of the strong interaction dynamics the effective strength of the Higgs-boson exchange dominates over that of the charged-vector-boson exchange. It is found that in gauge models in which there exist gauge singlet n-type and λ-type states or gauge singlet n-type, λ-type and SU(3) singlet q,q′ states, the nonleptonic $\Delta I = 1/2$ rule can be incorporated in a renormalizable manner through the introduction of massive neutral, scalar, non-Higgs intermediate bosons. In particular, it is shown that the SU_2^I realization of the nonleptonic $\Delta I = 1/2$ rule can be achieved in the chiral current-mixing gauge theories of weak and electromagnetic interactions of hadrons. (JFP)

22662 RELATIONS AMONG THE BARYON MAGNETIC MOMENTS AS A CONSEQUENCE OF $SL_{3,C}$. Zet, G. (Polytechnic Inst., Iasi). Lett. Nuovo Cim.; 7: No. 15, 772-774(11 Aug 1973).

The principal nondegenerate series of the unitary irreducible representations of the group SL(3,C) are described in order to obtain the Coleman–Glashow relations among the baryon magnetic moments in octet and decuplet. Also the magnetic-moment formula for the 27-plet is predicted. (JFP)

22663 SCALE INVARIANCE AND THE PHYSICS OF THE LIGHT CONE. Callan, C. G. Jr. (Inst. for Advanced Study, Princeton, NJ). pp 213-275 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The formal properties of scale and conformal transformations and their realizations in canonical field theories are first discussed. The extent to which formal properties can be maintained in the presence of interactions is then discussed, taking renormalized perturbation theory as a theoretical laboratory. The Wilson operator product expansion is introduced, and it is shown how the expansion allows the application of broken scale invariance ideas to physically accessible processes. It is discussed how a series of successively stronger hypotheses, starting with the hypothesis of canonical dimensions, allow one to rederive the quark parton model results for electroproduction-type processes. The problems and future prospects of this approach are finally discussed. (LBS)

Applications (Strong)

22664 ALGEBRA OF STRENGTHS GENERATED BY BILOCAL CURRENTS ACTING ON CONSTITUENT STATES. Gomberoff, L. (Tel Aviv Univ., Israel); Horwitz, L. P.; Ne'eman, Y. Phys. Lett.; 45B: No. 2, 131-135(9 Jul 1973).

Within the context of a free field model, a unitary transformation is introduced which carries the entire $[U(6) \times U(6)]_{gW}^{currents}$ of the current system, with subgroup $SU(6)_W^{currents}$, into newly defined $[U(6) \times U(6)]_{gW}^{strong}$, with diagonal subgroup $SU(6)_W^{strong}$, which commutes with the boost in the z-direction. Analysis of strong current-hadron scattering amplitudes in the deep Regge region permits the extraction of the hadron couplings to vector and tensor Regge exchanges as the matrix elements of "strong" charges. (auth)

22665 PROBLEMS OF INCLUDING AN SU(3) TWENTY-SEVEN IN THE STRONG-INTERACTION HAMILTONIAN DENSITY. Cornwell, D. T. (Univ., Karlsruhe, Ger.); Genz, H.; Katz, J.; Steiner, H. Nucl. Phys.; B59: No. 1, 211-221(1973).

Problems arising from including (as has been proposed) an SU(3) twenty-seven component in the Hamiltonian density of the strong interactions are discussed. For definiteness one of the simplest models providing a twenty-seven, the (8,8), is chosen. The resulting first-order mass formulas differ from the Gell-Mann–Okubo (GMO) relation, and the parameters of the model may be chosen such that the new formulas are exactly satisfied by the experimental masses. It is argued that this first-order formalism is particularly unreliable for effects depending on violation of the GMO mass formulas. Assuming its validity the KN σ-terms can be expressed by the πN σ-term, yielding values of at least 2,000 MeV for the former if any reasonable (i.e., positive) value for the latter is taken. This disagrees with phenomenological estimates of 400 MeV. Furthermore, the mass of the nucleon turns out to be negative in the chiral limit in disagreement with physical expectation. Both difficulties disappear when the twenty-seven part is excluded from the Hamiltonian in a first-order calculation. The contribution of the SU(3) twenty-seven to the Hamiltonian is also estimated in the scheme of Li and Pagels. (auth)

Scattering Theory

22666 (COO-3533-24) FIXED ANGLE BEHAVIOR IN FOUR POINT DUAL MODELS. I. Absolutely Convergent Series of Beta Functions. Gardiner, C. W. (Syracuse Univ., N. Y. Dept. of Physics). 1973. 34p. (SU-4205-24). Dep. NTIS $3.75.

The large s fixed angle asymptotic behavior of scattering amplitudes of the form $T(s,t,u) = A(s,t) + A(s,u) + A(u,t)$ with $A(s,t) = \sum_{j,k=0} C_{jk} B[h - \alpha(s), h - \alpha(t)]$ is studied. It is found that the asymptotic behavior is determined by the function $F(z) = \sum_{j=0} C_j z^j$. If $F(z)$ is entire, the Veneziano fixed angle behavior is preserved. If $F(z)$ is singular at $z = \lambda$, λ real and larger than one, a different, but still exponentially damped, fixed angle behavior is pro-

duced around the forward and backward regions. If $\lambda = 1$, one finds power law behavior, or asymptotic behavior that decreases faster than any power of s, but slower than any exponential. This behavior is found to be a slowly varying function of scattering angle, and is therefore probably unphysical. In particular it is found that the models of Mandelstam and Frampton have a power law fixed angle behavior with the power independent of angle. The same is true of the model at Gervais and Neveu, unless their choice $\alpha_0 = -1$ is made. It is considered therefore, that the first two of these models are unacceptable physically. The model of Neveu and Schwarz, however, does have the usual Veneziano fixed angle behavior. Also comments are made on the work of Ellis and Freund, pointing out that their statement that linearly rising trajectories necessarily give rise to exponentially damped transverse momentum distributions must be incorrect, the models of Mandelstam, etc. being counter-examples. (auth)

22667 (IFVE-STF-72-86) THREE BODY PROBLEM IN STRONG COUPLING THEORY. Semenov, S. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 31p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

The problem of three bodies, strongly interacting with a scalar field, was considered with the help of the N. N. Bogolubov method. The iteration scheme for energy and system wave function was constructed, and the equation of relative motion was obtained. A limiting case of this equation, corresponding to scattering problem, is considered. (auth)

22668 (ITF-73-36-E) J-PLANE ANALYSIS OF THE VENEZIANO AMPLITUDE WITH NONLINEAR TRAJECTORIES. Bugrii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

The structure of singularities of the Veneziano amplitude in the complex angular momentum plane is studied. The introduction of a nonlinear term in the trajectory essentially changes the properties of the partial amplitude as compared to the case of linear trajectories. In the J-plane, besides simple poles lying on the leading and on the conventional daughter trajectories, additional poles lying on mirage trajectories (situated below the leading trajectory) emerge. In the partial amplitude also nonreggeised poles in the S-plane emerge whose position is independent of the angular momentum. Such are, for example, the ancestors. (auth)

22669 (ITF-73-68-E) THRESHOLD BEHAVIOUR OF THE THREE PARTICLE SCATTERING AMPLITUDE AND GAS APPROXIMATION IN THE MANY-BODY PROBLEM. Simenog, I. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

It is established by investigation of the gas approximation for the ground state energy in the many-body problem how the low energy parameters of the two-particle and essentially three-particles scattering amplitude determine the dominant terms of the energy expansion in series of gas parameter. The correspondence to the gas approximation in the Faddeev integral equations in the form of the three-particle amplitude low energy behavior near the threshold $E \to 0$ is obtained. (auth)

22670 (JINR-P4-7107) PHASE FUNCTION METHOD IN RELATIVISTIC THEORY OF QUASI POTENTIAL SCATTERING. 2. Three-Body Problem. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 22p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

Generalization of the phase function method is made for the case of interaction of three relativistic particles on the basis of quasipotential approach. (auth)

22671 METHOD OF MULTICHANNEL COUPLING AND THE FADDEEV EQUATION. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 2, 149-157(1973). (In Russian).

In the framework of the method of multichannel coupling, the transition from a system of multidimensional Faddeev equations to a system of one-dimensional integral-differential equations was made. A method was proposed for the solution of the equations obtained, suitable for a description of the system at energies above threshold energy. (tr-auth)

22672 MOMENT METHODS FOR SOLVING SINGULAR INTEGRAL EQUATIONS IN SCATTERING THEORY. Osborn, T. A. (Stanford Univ., CA). Nucl. Phys.; A211: No. 1, 211-220(1973).

The use of moment methods for obtaining approximate numerical solutions to singular integral equations is studied. With the techniques developed one can obtain accurate solutions to these singular integral equations using matrices with dimensions smaller than 10×10. (auth)

22673 INTEGRAL EQUATIONS FOR N-PARTICLE SCATTERING. Bencze, G. (Univ. of Helsinki). Nucl. Phys., A210: No. 3, 568-578(1973).

Integral equations are derived for the N-particle transition operators. The equations couple together only transition operators between two-body channels. The kernel of the equations becomes connected after a single iteration. Transition operators involving channels with three or more particles can be obtained by quadratures from the solution of the equations. It is also shown that the N-particle equations can be reduced to multichannel two-body equations by the use of the quasi-particle method. (auth)

22674 ONE-DIMENSIONAL SCATTERING OF PLANE WAVES BY AN ARBITRARY POTENTIAL. Pavlov, B. S. (Leningrad State Univ.). Teor. Mat. Fiz.; 16: No. 1, 105-115(Jul 1973). (In Russian).

The scattering problem is solved for the wave equation with the nonnegative potential $q(x) = 0$, $x < 0$ in one dimension. It is shown that the reflection coefficient (nonunitary, in general case) coincides with the diagonal matrix element of the complete unitary S-matrix. (auth)

22675 OBTAINING OF THE RENORMALIZED S-MATRIX BY MEANS OF THE SMOOTH CUTTING OFF THE HAMILTONIAN OVER THE SPACE VARIABLES. Likhachev, V. N. (Moscow Engineering Physics Inst.). Teor. Mat. Fiz.; 16: No. 1, 33-41 (Jul 1973). (In Russian).

The renormalized S-matrix corresponding to the translation-invariant Hamiltonian is obtained. The connection between this matrix and the S-matrix corresponding to the Hamiltonian with smooth spatial cut-off is demonstrated. (auth)

22676 LOCAL TWO-PARTICLE QUASIPOTENTIAL IN THE RELATIVISTIC THREE-PARTICLE PROBLEM. Kvinikhidze, A. N.; Stoyanov, D. Ts. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 16: No. 1, 42-51(Jul 1973). (In Russian).

The possibility of using the quasipotential, which is local in the pair-interaction approximation, in the three-particle relativistic three-dimensional equations is discussed. It is shown that the part of this quasipotential corresponding to the pair-interaction can be expressed by two-particle physical on-shell amplitudes (decomposition in powers of the weak coupling constant is unnecessary). It is proved that all 16 amplitudes obtained as the solutions of these equations on the mass-shell coincide with the correct physical amplitudes. (auth)

22677 SPIN MODIFICATION OF THE RELATIVISTIC EIKONAL MODEL. Humpert, B.; Quiros, M. (Univ., Geneva). Nucl. Phys.; B59: No. 1, 141-165(1973).

The modifications of the relativistic eikonal model due to nucleon spin are investigated in a ladder graph model with scalar exchanges only. The method of Feynman parameters is used. (auth)

22678 ANALYTICITY, UNITARITY, AND SCATTERING AMPLITUDES. Martin, A. (CERN, Geneva). pp 169-212 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

The results of local field theory on analyticity properties of scattering amplitudes on the mass shell are first reviewed. The remaining sections deal with the following topics: positivity and enlargement of the analyticity domain; high energy bounds; spin complications and superconvergence relations; extension of analyticity and bounds to inelastic reactions; the Pomeranchuk theorem and related questions; and rigorous constraints on the $\pi\pi$ amplitude. (LBS)

22679 SUMMING HELICITY AMPLITUDES. Abbe, W. J. (Univ. of Georgia, Athens). Bull. Ga. Acad. Sci.; 31: No. 3, 113-117(Jun 1973).

The main results are that if the "simpler" sums for $g_1^{\pm}(z)$, $g_2^{\pm}(z)$, and the corresponding equations for half-integral J can be performed for all z, for given b_J, the full scattering amplitude may thus be constructed by solving an integral equation. It might be objected that even these sums are difficult to perform in general, and that therefore the method is of little value. However, sums of the given form were performed for specific representations of the b_J (Abbe and Gary, 1968), and techniques for performing the sums involving the factor $\{[(J-\lambda)!\,(J-\mu)!\,]/[(J+\lambda)!\,(J+\mu)!\,]\}^{\frac{1}{2}}$ will be presented elsewhere. While Regge techniques can be used to perform them, this involves a number of separate assumptions regarding the analytic properties of the b_J in the J-plane (Gell-Mann, et al., 1964). However, it may be possible to use the techniques of previous work (Abbe and Gary,

1968) to perform these sums directly. This problem is presently being studied. (auth)

22680 NON-EXHAUSTIVE RESTATEMENT OF THE ANGULAR MOMENTUM REDUCTION IN THE THREE-BODY PROBLEM. Baz, E. E.; Fayard, C.; Lamot, G. H.; Pigeon, J. (Univ. Claude Bernard, Lyon). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 243-266 (1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

A brief description of the present status in the angular momentum reduction in the three-body problem is given. First the OMNES' symmetrical method is restated. There are then presented three unsymmetrical methods derived from the Ahmadzadeh and Tjon's work, the first one, due to Grubman, uses a particular determination of the body-fixed axis. In the second method one uses the well known expansion of a spherical harmonic the argument of which is a sum of two vectors. The third method starts from the Faddeev–Lovelace formalism and also uses the above expansion of a spherical harmonic. A comparison between these methods is made on the particular (n–d) case. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

22681 (ORO-3992-111) AETHER AS A SUPERFLUID. Sudarshan, E. C. G. (Texas Univ., Austin. Center for Particle Theory). Jan 1971. 15p. (CPT-165). Dep. NTIS $3.00.

22682 GAS–LIQUID PHASE TRANSITION IN THE SYSTEM OF SURFACE IMPURITIES OF ^{3}He IN SUPERFLUID SOLUTIONS. Andreev, A. F.; Kompaneets, D. A. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 268-270 (5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 376-379(5 Apr 1973).

It is shown that a first-order phase transition should be observed on the free surface of an ^{3}He solution in helium II. This transition is due to condensation of the surface impurities and is accompanied by a kink on the plot of the surface tension against the temperature. (auth)

22683 SOUND PROPAGATION IN SOLUTIONS OF TWO SUPERFLUID LIQUIDS. Khalatnikov, I. M. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 386-389 (5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 534-538(5 May 1973).

An attempt is made to study the question of the hydrodynamic properties of a mixture of two superfluids, and to study the propagation of sound in such mixtures. (MHR)

22684 TEMPERATURE DEPENDENCE OF PHONON VELOCITY AND ROTON MINIMUM IN LIQUID He II. Kebukawa, T. (Osaka Univ., Toyonka, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 2, 388-400(Feb 1973).

The temperature dependence of phonon velocity and roton minimum is investigated from the microscopic point of view, by taking into account the contributions from the interactions between quasiparticles given in previous papers. In consequence, it is found that the phonon–roton interactions and the roton–roton interactions play very important roles in the temperature dependence of phonon velocity and roton minimum, respectively. The results are compared with experiments to yield fairly good agreement. (auth)

22685 NEW COOLING EFFECT. Revzen, M. (Technion-Israel Inst. of Tech., Haifa). Phys. Lett.; 44A: No. 6, 397(16 Jul 1973).

Adiabatic rotation of ^{4}He in packed powder is shown to provide a new cooling effect. Using a simplified model and some experimental parameters it is estimated that $(\Delta T/T)_{1^\circ K} \approx -0.25^\circ$K. (auth)

Superconductivity

Refer also to abstracts 21965 and 22030.

22686 TEMPERATURE DEPENDENCE OF THE CHANGE OF RATE OF PLASTIC DEFORMATION OF LEAD IN SUPERCONDUCTING TRANSITIONS. Bobrov, V. S.; Gutmanas, E. Yu. (Inst. of Solid State Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 3, 95-97(5 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 3, 137-140(5 Feb 1973).

It follows from the agreement between the temperature dependences of the experimentally determined ratio of the rates of plastic deformation of lead in the normal (N) and superconducting (S) states in SN transitions, on the one hand, and the function describing the ratio of the electronic viscosities in the S and N states, on the other, that the plastic deformation of Pb at helium temperatures is determined by electronic drag of the dislocations. (auth)

22687 SUPERCONDUCTIVITY OF LUTECIUM. Nikulin, E. I.; Volkenshtein, N. V.; Startsev, V. E. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 337-339(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 470-472(5 May 1973).

The electric resistance of lutetium was measured in the temperature range 0.03 to 4.2°K. A transition to the superconducting state was observed in the purest (99.9%) samples containing no ferromagnetic impurities. The transition temperature is T_c = 0.10 ± 0.03°K and the critical magnetic field is H_c < 400 Oe. (auth)

22688 ROLE OF LINEAR CHAINS IN THE FORMATION OF THE PROPERTIES OF SUPERCONDUCTORS WITH A-15 STRUCTURE. Gor'kov, L. P. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 379-383(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 525-529(5 May 1973).

It is shown that the elastic properties of superconductors with β-W structure follow from the assumption that the α-electron energy spectrum is almost flat. (auth)

22689 ALGORITHM FOR SOLVING FERMION SYSTEMS. II. Solvable Model for the Josephson Effect. Eckmann, J. P.; Guenin, M. (Univ., Geneva). Nuovo Cim., 16B: No. 1, 93-105 (11 Jul 1973).

The Josephson junction is described by a microscopic model in which there is no dissipation in the junction. The superconductor is described by the BCS Hamiltonian before transition to the thermodynamical limit and with no momentum exchange. Macroscopic causality is used, and the canonical ensemble is used for the description of the state of the system. The model is explicitly solved without any approximations. (MHR)

22690 SUPERCONDUCTIVITY IN THE PALLADIUM–HYDROGEN SYSTEM. Auluck, S. (Univ. of Arizona, Tucson). Lett. Nuovo Cim.; 7: No. 13, 545-549(28 Jul 1973).

It is assumed that H in Pd can be viewed as the first example of "metallic hydrogen," and from the available experimental data, a superconducting transition temperature of about 22°K is estimated for metallic hydrogen. (MHR)

22691 SUPERCONDUCTIVITY IN NONEQUILIBRIUM WITH REPULSION BETWEEN PARTICLES. Kirzhnits, D. A.; Kopaev, Yu. V. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 270-273(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 379-382(5 Apr 1973).

A model is discussed in which the time of recombination of electrons and holes has been appreciably increased and superconductivity may be expected to appear as a result of a single action of the pump pulse. (MHR)

22692 CALCULATION OF PROPAGATION VELOCITY OF NORMAL AND SUPERCONDUCTING REGIONS IN COMPOSITE CONDUCTORS. Altov, V. V.; Kremlev, M. G.; Sytchev, V. V.; Zenkevitch, V. B. (Inst. of High Temperatures, Moscow). Cryogenics; 13: No. 7, 420-422(Jul 1973).

The calculation of the velocity of propagation of normal (or superconducting) regions along composite conductors is calculated taking into account current sharing between superconductor and normal substrate. Different peculiarities in the dependence of velocity on the current are discussed and the results are compared with some experimental data. (auth)

22693 ASYMMETRIC SPLIT-PAIR SUPERCONDUCTING MAGNET FOR NUCLEAR POLARIZATION EXPERIMENTS. Gilbert, E.; Hanley, P.; Hayter, J. B.; White, J. W. (Oxford Instrument Co.). J. Phys., E (London); 6: No. 8, 714-718(Aug 1973).

To meet the rigorous requirements of a polarized neutron diffraction experiment using a dynamically polarized proton target, a superconducting magnet has been constructed with magnetic field homogeneity better than 1 part in 10^4 over a 1 cm^3 sample volume. It has also the essential characteristics of wide angular access to the sample, and, to avoid depolarization of the neutron spin, no field nodes in the neutron beam line. To achieve these specifications an asymmetric split-pair coil configuration, coaxial with a smaller pair of fourth order correction coils, was used. Series coil interconnection minimizes power supply complexity, and the design is compact enough to meet a critical size restriction imposed by the polarized neutron spectrometer at AERE, Harwell, on which the magnet will be used. The approach used provides some useful techniques for the design of homogeneous field magnets in general. (auth)

22694 ANISOTROPY OF THE CRITICAL CURRENT DENSITY IN SUPERCONDUCTING NIOBIUM–TITANIUM WIRES. Enderlein, G.; Handstein, A.; Lange, F.; Verges, P. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Cryogenics; 13: No. 7, 426-429(Jul 1973).

The critical current density in wires of an Nb–64 at. % Ti alloy was determined in axial and circular directions by various methods. Owing to the cell structure due to cold deformation an anisotropy in the critical current density ($j_{c,axially} < j_{c,circularly}$) is present in the wires. There is no major difference between magnetization currents and transport currents. Therefore it should be possible in principle to obtain the high critical current densities determined from circular magnetization currents by suitable defect structure with axial transport currents too. (auth)

22695 POSSIBLE SUPERCONDUCTING PHASE TRANSITION IN Fe_2Te_3. Atzeri, S.; Mula, G. (Univ., Cayliari, Italy). Solid State Commun.; 13: No. 2, 157-158(15 Jul 1973).

A superconducting phase transition is predicted for Fe_2Te_3 on the basis of an empirical determination of the electron–phonon coupling constant λ. This result is shown to be consistent with recent calculations of the superconducting state parameters. (auth)

22696 SUPERCONDUCTIVITY. Nemoz, A. (CNRS, Grenoble, France). pp 379-406 of Electronic Properties of Metals and Alloys. Janot, C. (comp.). Paris; Masson (1973). (In French).

From summer school of physical metallurgy; Royan, France (13 Sep 1971).

The theory demonstrates that the study of superconducting properties and the improvement of performance always requires an excellent knowledge of the physical and metallurgical structure of the metals. On the other hand, the superconducting measurements are used for precipitation studies. (FR)

22697 STABILITY OF OXIDE BARRIERS IN JOSEPHSON TUNNEL JUNCTIONS. Otschik, P. (Zentrum fuer Forschung und Technik, Dresden). Phys. Status Solidi (a); 18: No. 1, K45-K48(16 Jul 1973).

It is assumed that diffusing species are responsible for the observed instabilities, and storage conditions necessary to stop the fast diffusion process (grain-boundary diffusion of metallic species) are derived. The electric field disadvantageous for stability is estimated to be $\sim 10^6$ V/cm. Temperature–time functions are calculated for the diffusion of various metallic species (Sn to W) into the grain boundary of the oxide over a distance of 20 Å through a field of 10^6 V/cm. A tunnel junction is defined to be stable if metallic species need 10^4 d (>20 y) in order to diffuse 20 Å into the grain boundary. Tunnel junctions from high-melting superconductors do not need to be cooled during storage. Experimental results for storage of Sn and V/Pb tunnel junctions are evaluated. (DLC)

22698 V–V_xO_y–Pb JOSEPHSON TUNNEL JUNCTIONS OF HIGH STABILITY. Seifarth, H.; Rentsch, W. (Zentrum fuer Forschung und Technik, Dresden). Phys. Status Solidi (a); 18: No. 1, 135-146(16 Jul 1973).

Investigations were made on $V/V_xO_y/Pb$ Josephson junctions where the V_xO_y barrier is produced by plasma oxidation at the surface of V-stripe conducter. Relations between the evaporation conditions and the electric and superconducting properties of V films and fabrication of Josephson junctions were studied. Characteristic parameters of the Josephson junctions were determined from the U–I characteristic and the magnetic field dependence of critical Josephson current. Results on stability of the $V/V_xO_y/Pb$ Josephson junctions against temperature changes and storage at atmospheric air and room temperature over 430 d are discussed. (12 figures, 30 references). (auth)

22699 SUPERCONDUCTING TRANSITION OF STRONG-COUPLING THIN FILMS. Pinel, J.; Lebeau, C. (Institut National des Sciences, Rennes, France). Phys. Status Solidi (a); 18: No. 1, 183-187(16 Jul 1973).

The transition fields $H_T(t)$ of Pb–Bi thin films (0.5 and 1 at. % Bi), placed in a transverse field, were measured up to reduced temperatures $t = T/T_c$ as high as 0.99. Values are given of the reduced field $h^*(t) = H_T(t)/T_c\,\delta$ with $\delta = -(dH_T/dT)_{T_c}$, the values of the coherence length $\xi(t)$, and of the Ginzburg–Landau parameter $\varkappa(t)$ particularly near the critical temperature T_c ($\varkappa(t)$ varies between 0.59 and 0.71). The results show that $h^*(t)$ essentially depends on the effective mean free path l of the films: for films with $l \approx \xi_0$ (ξ_0 B.C.S. coherence length) the data points $h^*(t)$ fall practically on the same curve. The observed discrepancy between the experimental values and theoretical predictions for $h^*(t)$ is attributed to gap anisotropy effects. (auth)

22700 INFLUENCE OF THE SUPERCONDUCTING PHASE TRANSITION ON PLASTIC PROPERTIES OF METALS AND ALLOYS. Kostorz, G. (Institut Laue-Langevin, Grenoble, France). Phys. Status Solidi (b); 58: No. 1, 9-42(1 Jul 1973).

A review of the rapidly growing field of plasticity research of superconductors is presented. Most of the experimental work was stimulated by the anomalous decrease of the critical resolved shear stress of lead at low temperatures, and by the prediction of special dynamic effects in superconductors, where only a very small drag remains at temperatures well below T_c. Many interesting effects of the transition superconducting ⇌ normal on plastic properties are now well established. They can all be summarized under the term "enhanced plasticity of superconductors". After presentation of experimental results and theoretical models, the current state of understanding of these new phenomena is discussed. (114 references) (auth)

22701 STABILITY BOUNDARY OF THE SUPERCONDUCTING STATE IN A TYPE I SUPERCONDUCTOR. Smirnov, A. P.; Totubalin, V. N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 14: No. 8, 2066-2068 (Feb 1973).

Investigations of the current transitions at various temperatures and magnetic fields have been carried out for tin single crystals with perfect surfaces. In the presence of an external longitudinal field an instability of the superconducting state is observed before final transition to the intermediate state, which manifests itself in an oscillatory change of the resistance with time. This phenomenon involves spiral twisting of the current as it redistributes itself over the cross section of the sample, i.e., with the development of dynamical paramagnetism and diamagnetism. A family of current transitions in magnetic fields at various temperatures was obtained and used to construct the phase diagram for a type I superconductor in field and current coordinates. (auth)

22702 LOW-FREQUENCY ABSORPTION IN THE MIXED STATE OF TYPE II SUPERCONDUCTORS. Smirnov, A. P.; Totubalin, V. N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 14: No. 8, 2150-2152 (Feb 1973).

The audio-frequency (0.3–30 kHz) impedance of Nb and Sn + 5% In alloy were measured. The observed frequency dependence of the impedance is attributed to vortex oscillations. (CES)

22703 EXTERNALLY SHUNTED JOSEPHSON JUNCTIONS. Fulton, T. A. (Bell Telephone Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 7: No. 3, 1189-1193 (1 Feb 1973).

Recent experiments on externally shunted Josephson junctions by Hansma, Rochlin, and Sweet were interpreted as being in accord with the model of Stewart and McCumber. This interpretation is questioned for that portion of their experiments which employed shunts of relatively large inductance, in view of an underestimate of the effect of the inductance, and an alternate interpretation of the observed behavior in these situations is suggested. The interpretation of similar experiments of Buckner, Chen, and Langenberg is also questioned for similar reasons. (auth)

22704 COMMENTS ON SUPERCONDUCTING SURFACE RESISTANCE. Alig, R. C. (RCA Laboratories, Princeton, New Jersey 08540). Phys. Rev. B 7: No. 3, 1188-1189 (1 Feb 1973).

The author believes a recent letter by Passow contains several inconsistent and misleading statements, (auth)

22705 IMPLICATIONS OF SOLID-STATE CORRECTIONS TO THE JOSEPHSON VOLTAGE-FREQUENCY RELATION. Fulton, T. A. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 7: No. 3, 981-982 (1 Feb 1973).

The intimate connection between the Josephson voltage–frequency relation $V = \Gamma d\phi/dt$ and flux conservation in closed superconducting geometries implies that any dependence of Γ on materials, temperature, voltage, or other nonexotic variables is in violation of Faraday's law. (auth)

22706 MICROWAVE SURFACE RESISTANCE OF TYPE-II SUPERCONDUCTORS IN THE VORTEX STATE. Pedersen, R. J. (Aerospace Corporation, El Segundo, California 90245); Kim, Y. B.; Thompson, R. S. Phys. Rev. B 7: No. 3, 982-990 (1 Feb 1973).

We have measured the microwave surface resistance of various Nb–Ta and Pb–In superconducting alloys using a derivative technique to determine its rate of change with field near H_{c2}. Previous dc measurements of this slope have generally been interpreted to show agreement with the Caroli–Maki theory, which Thompson has found to be incomplete. Our measurements show a region of constant slope somewhat below H_{c2} with a magnitude in agreement with the dc results, but also show that the slope increases rapidly to approach the Thompson values in the limit $H \to H_{c2}$. Theoretical arguments are presented indicating why the two theories can have different regions of validity. (auth)

22707 ANISOTROPIC SUPERCONDUCTIVITY IN LAYER COMPOUNDS. Morris, R. C.; Coleman, R. V. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. B 7: No. 3, 991-1001 (1 Feb 1973).

Measurements of the angular dependence of the upper critical field H_{c2} in the transition metal dichalcogenides TaS_2–(pyridine), TaS_1Se_1, TaS_1Se_1–(pyridine), $TaS_{1.2}Se_{0.8}$, and $TaS_{0.8}Se_{1.2}$ have been made in magnetic fields up to 150 kOe. The observed angular dependence has been compared to simple theoretical models in order to estimate the anisotropy of the coherence length ξ in these materials. The values of the $\xi_a mN/\xi_c$ calculated from the data were 20 for TaS_2–(pyridine) and approximately 7 for the TaS_2, TaS_1Se_1 and TaS_1Se_1–(pyridine). The alloys with different ratios of sulfur and selenium showed no major change in behavior as compared to TaS_1Se_1. The results are also discussed in relation to a generalized effective-mass model of anisotropic electronic conduction. The resistive transitions in the intercalated materials for field orientations less than 10° from the parallel orientation

are extremely broad and also exhibit unusual structure connected with enhanced flux-flow resistance. The magnetoresistance behavior in the normal state of the pure and intercalated layer compounds has also been measured and the changes in anisotropy due to intercalation are discussed. (auth)

22708 MAGNETIC FIELD DEPENDENCE OF THE SURFACE RESISTANCE OF PURE AND IMPURE SUPERCONDUCTING ALUMINUM AT PHOTON ENERGIES NEAR THE ENERGY GAP. Budzinski, W. V.; Garfunkel, M. P.; Markley, R. W. (University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. B 7: No. 3, 1001-1016 (1 Feb 1973).

The magnetic field dependence of the microwave absorptivity of superconducting aluminum single crystals has been determined in the frequency range 15–100 GHz, covering the spectrum near the superconducting energy gap. Measurements were made on samples of varying purity, from the purest available aluminum to aluminum doped with 3-at.% silver. In the pure case, the energy of the absorption edge was found to shift with static magnetic field by an amount of the order pv, where p is the Fermi momentum and v is the drift velocity associated with the Meissner current. The addition of impurities was found to reduce the shift in the absorption edge as expected. Furthermore, the impurities coupled with the static field to induce an unexpected effect, namely, an absorption peak near the energy of the zero-field absorption edge. The amplitude of the absorption peak was found to increase monotomically with both magnetic field and with concentration of the silver impurity. A suggestion is made that impurities and magnetic field induce a change in the BCS coherence factors (from case II to case I) which, in turn, is responsible for the absorption peak. (auth)

22709 EFFECT OF PARAMAGNETIC IMPURITIES ON JOSEPHSON CURRENTS THROUGH JUNCTIONS WITH NORMAL-METAL BARRIERS. Kumar, P. (Department of Physics, University of Roorkee, Roorkee, India). Phys. Rev. B 7: No. 3, 1016-1019 (1 Feb 1973).

The present paper deals with a study of the effect of paramagnetic impurities on zero-bias Josephson currents through junctions with normal-metal barriers at T=O °K. The ratio of the barrier supercurrent of the impure-SNS (superconductor-normal-metal-superconductor) junction to that of the pure-SNS junction is found to be equal to $1-\zeta$, where ζ is a measure of the impurity concentration. For $\zeta<1$, the Josephson current is nonzero and decreases with increase of impurity concentration, but in the gapless region ($\omega_t=O$) when $\zeta\geq 1$, the current is zero for $\zeta=1$ and then becomes negative for $\zeta>1$. At $\zeta=0$, the result is in exact agreement with that of Ishii for the pure case. (auth)

22710 MODEL FOR AN EXCITON MECHANISM OF SUPERCONDUCTIVITY. Allender, D.; Bray, J.; Bardeen, J. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 7: No. 3, 1020-1029 (1 Feb 1973).

The exciton mechanism of superconductivity is discussed with respect to a particular model, a thin metal layer on a semiconductor surface. In this model, the metal electrons at the Fermi surface tunnel into the semiconductor gap where they interact with virtual excitons, producing a net attractive interaction among the electrons in direct analogy with the phonon mechanism of superconductivity. The physical requirements for successful realization of the exciton mechanism in a metal–semiconductor system are explored in detail, and the relevant parameters are described. Estimates are made for electron tunneling and band-bending effects, and an electron–exciton coupling constant is defined and estimated. Finally, an appropriately modified integral equation for the superconducting energy gap is solved numerically to yield transition temperatures both for a pure-exciton mechanism and for the exciton and phonon mechanisms acting simultaneously. (auth)

22711 ELECTRON SPIN RESONANCE AND SUPERCONDUCTIVITY IN $Gd_x La_{1-x}Al_2$ INTERMETALLIC COMPOUNDS. Davidov, D.; Chelkowski, A.; Rettori, C.; Orbach, R. (Department of Physics, University of California, Los Angeles, California 90024); Maple, M. B. Phys. Rev. B 7: No. 3, 1029-1038 (1 Feb 1973).

Electron-spin-resonance measurements of Gd in $LaAl_2$ exhibit appreciable change of the g value and linewidth upon alloying with other nonmagnetic impurities. This indicates the existence of a "bottleneck" effect—the relaxation rate for the conduction electrons to the Gd ions δ_{sl} exceeds that to the lattice δ_{sL}. We are able to shift the g value from $g=1.988\pm0.003$ to $g=2.11\pm0.01$, opening the bottleneck completely. The intermetallic compounds $GdLa_{1-x}Al_2$ are Abrikosov–Gorkov superconductors in the dilute limit. Measurements of the transition temperature and the upper critical field depend upon δ_{sl} directly and δ_{sL} indirectly. We are thus able to obtain parameters which determine superconducting critical-field and temperature behavior from magnetic resonance experiments. (auth)

22712 SYNTHESIS OF SUPERCONDUCTING COMPOUNDS BY EXPLOSIVE COMPACTION OF POWDERS. Roy, U.; Otto, G. H.; Reece, O. Y. (to National Aeronautics and Space Administration). U. S. Patent 3,752,665. 14 Aug 1973. Filed date 8 Jul 1971. 4p.

Superconducting intermetallic compounds such as Nb_3Sn are prepared by disposing a finely divided, stoichiometric mixture of elemental metal powders in a container, surrounding the container with an explosive and detonating the explosive. The resulting explosive shock wave provides the necessary reaction conditions for compound formation. (auth)

22713 SUPERCONDUCTIVITY OF FILMS OF NIOBIUM AND ALUMINA MIXTURES. Osipov, K. A.; Orlov, A. F.; Borovich, T. L.; Milai, A. K.; Sobieva, L. S. (Inst. of Metallurgy, Moscow). Fiz. Metal. Metalloved.; 35: No. 6, 1174-1178(1973). (In Russian).

Electrical properties of films of mixtures of Nb with aluminum oxide of different composition, obtained by the simultaneous condensation on supports in a high vacuum, were studied. The superconductivity of the films was maintained at aluminum oxide contents in the mixture up to ~20 at. % (38 vol. %). A second critical field H_{c2} and current-carrying capacity of the film in the magnetic field at 4.2°K increase with oxide content up to 8 to 10 at. %. Analysis of the change of the critical current density in the magnetic field indicates the formation in the film of compound states and rigid immobilization of the magnetic current at all investigated intervals of the field. (tr-auth)

22714 HOMOGENEITY DOMAINS OF SUPERCONDUCTING PHASES IN THE Mo–Pt SYSTEM. Fluekiger, R.; Yvon, K.; Susz, C.; Roggen, R.; Paoli, A.; Muller, J. (Univ., Geneva). J. Less-Common Metals; 32: No. 2, 207-225(Aug 1973). (In French).

Investigation of Mo–Pt alloys up to 55 at. % Pt by means of metallography, x-ray diffractometry, hardness measurements, superconductivity and resistivity measurements for various thermal treatments shows that the phase diagram at high temperatures needs revision. In particular, the partially ordered ϵ' hexagonal phase of the $Ni_3Sn(DO_{19})$-type is responsible for the maximum superconducting transition temperatures. 11 figures, 25 references. (auth)

22715 MAGNETIC SUSCEPTIBILITY OF DEGENERATE ELECTRON GAS INTERACTION OF NUCLEAR MAGNETIC MOMENTS IN NORMAL METALS AND SUPERCONDUCTORS. Gabovich, A. M.; Pashitskii, E. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 6, 898-905(Jun 1973). (In Russian).

Static magnetic susceptibilities of normal and superconducting electron gas were calculated by means of macroscopic electrodynamic approach based on the Lindhard formula connecting magnetic permeability with transversal and longitudinal dielectric constants of the medium with space and time dispersion. A formula is obtained for the energy of nuclear magnetic moments interaction in normal metals. It is shown that logarithmic singularity at the point $q = 2k_F$ characteristic of magnetic susceptibility of degenerate electron gas disappears in transition from a normal state to a superconducting one, which may affect the character of ordering nuclear spins in superconductors, as well as the magnitude of the Kohn anomalies in the spectrum of spin waves under condition of simultaneous existence of ferromagnetism and superconductivity. (auth)

22716 CRITICAL CURRENT OF GRANULAR SUPERCONDUCTORS. Deutscher, G. (Univ. of Tel Aviv, Israel). Rev. Phys. Appl.; 8: No. 2, 127-129(Jun 1973).

The transverse critical current of a multilayer system made of thin films separated by Josephson barriers is calculated. It is shown that for very thin barriers, the critical current is inversely proportional to the square root of the effective resistivity, whereas, for thicker barriers it is inversely proportional to the resistivity. (FR)

22717 PSEUDOPOTENTIAL CALCULATION OF THE EFFECT OF PRESSURE ON THE FERMI SURFACE AND SUPERCONDUCTING TRANSITION TEMPERATURE OF THALLIUM. Holtham, P. M. (British Columbia Univ., Vancouver). J. Phys., F. (London); 3: No. 7, 1361-1372(Jul 1973).

A local pseudopotential model, which includes the effect of spin-orbit coupling, was used to calculate the effect of pressure on cross sectional areas of the Fermi surface of thallium. The calculated results are compared with the experimental values measured using the de Haas–van Alphen effect reported by Anderson et al (Anderson, J. R., Schirber, J. E., and Stone, D. R.; 1970 Colloq. Int. sur les Proprietes Physiques des Solides sous Pression, Grenoble 1969 (Paris: CNRS) pp 131-7). The interpretation by Makarov et al (Makarov, V. I. and Bar'yakhtar, V. G.; 1965 Zh. eksp. teor. Fiz. 48, 1717-22, Sov. Phys.-JETP 1965, 21 1151-4) of the anomalous pressure variation in the superconducting transition temperature as due to a topology change in the Fermi surface is confirmed. Two topology changes that occur in thallium

are considered and show that the minute fourth zone electron pockets (situated along the line Γ to M) reported by Capocci et al (Capocci, F. A., Holtham, P. M., Parsons, D. and Priestley, M. G.; J. Phys. C: Solid St. Phys. 1970, 3, 2081-91) have just the correct Fermi energy to cause a nonlinear variation in T_c as the pressure is varied. (auth)

22718 THEORY OF PHOTON ASSISTED TUNNELLING IN SUPERCONDUCTORS. 2. Hasselberg, L. E. (Kungliga Tekniska Hoegskolan, Stockholm). J. Phys., F (London); 3: No. 7, 1453-1462(Jul 1973).

The formalism of a previous article (Hasselberg 1973) (J. Phys. F. 3(7) July 1973 1438-52) is used for deriving an expression of the second order tunnelling current density. The standing wave model by Hamilton and Shapiro (1970) (Phys. Rev. B: 2, 4494-503) is used to make it possible to describe the experiments in a satisfactory way. The effect of gap anisotropy of the films is also studied. By this, otherwise divergent expressions are avoided, and an auxiliary parameter introduced by Takayama (1971) (Prog. Theor. Phys. 46, 1-14) can be estimated. (auth)

22719 ULTRASONIC ATTENUATION IN SUPERCONDUCTORS. Theory of the Effect of Andreev Scattering. Forgan, E. M. (Univ. of Birmingham, Eng.). J. Phys., F (London), 3: No. 7, 1429-1437 (Jul 1973).

The effect on ultrasonic attenuation in superconductors of "Andreev" scattering—the scattering of electronic excitations by spatial variations of the order parameter is investigated. The result at small ql (q is the sound wavevector and l the electron mean free path) agrees with previous theoretical work, whereas that at large ql shows a new and unusual dependence of attenuation on Andreev and impurity scattering rates. The applicability of this theory to clean type-II superconductors near H_{c1} and H_{c2} is investigated. (auth)

22720 FLUCTUATION SCATTERING OF LIGHT ABOVE THE CRITICAL TEMPERATURE OF A SUPERCONDUCTOR. Tilley, D. R. (Essex Univ., Colchester, Eng.). J. Phys., F (London); 5: No. 7, 1417-1428(Jul 1973).

The cross section for inelastic scattering of light is calculated in the "Curie–Weiss" temperature region where the dc conductivity diverges as $(T - T_c)^{-\frac{1}{2}}$ for a bulk specimen. The analog of the Aslamazov–Larkin diagram is evaluated and a cross section which diverges as $(T - T_c)^{-\frac{1}{2}}$ in the bulk and as $(T - T_c)^{-2}$ is found for a thin film specimen. These factors are multiplied by lineshape functions which characterize the slowing down of the fluctuations above the phase change. The numerical magnitudes for transmission scattering, which is a practical case since some tungsten bronzes are transparent superconductors, are estimated. For a bulk, dirty specimen with a mean free path of 100 Å, a conservative estimate for the Rayleigh ratio per unit wavenumber is $2.7 \times 10^{-12} T^{\frac{1}{2}} (T - T_c)^{-\frac{1}{2}}$. An estimate for a transmission experiment of the magnitude of the cross section for scattering in the superconducting state is also given. (auth)

22721 LOW TEMPERATURE SPECIFIC HEAT CAPACITY OF THE $CeRu_2$ CONTAINING GADOLINIUM, TERBIUM, OR YTTRIUM. Rupp, G. (Siemens AG, Erlangen, Ger.). J. Phys., F (London); 5: No. 7, 1403-1416(Jul 1973).

Specific heat capacity measurements were made at temperatures between 1.8 and 20 K in vacuum magnetic induction up to 4 T on $Ce_{1-x}Y_xRu_2$ ($x = 0.16$ and 0.20). A magnetic contribution to the specific heat, resulting from the ordering of the rare earth ions, is shown to exist even at temperatures below the superconducting transition temperature T_c. The magnetic ordering is proved to grow steadily with decreasing temperature. It is not influenced by T_c. For alloys containing gadolinium it is completed at absolute zero. For alloys containing terbium the ordering is complicated by a crystal field producing an overall splitting of more than 20 K. The existence of a jump in the specific heat at T_c shows that superconductivity is a volume effect. Whether the total volume is superconducting or not is uncertain because of lack of an appropriate theory for this jump in samples in which superconductivity and magnetic ordering coexist. (auth)

22722 THEORY OF PHOTON ASSISTED TUNNELLING IN SUPERCONDUCTORS. 1. Hasselberg, L. E. (Kungliga Tekniska Hoegskolan, Stockholm). J. Phys., F (London); 3: No. 7, 1438-1452(Jul 1973).

An expression for the current density in a tunnel junction caused by an electromagnetic field is derived. The calculations are realized with the Matsubara (1955) (Prog. Theor. Phys. 14, 351-78) method of imaginary times. The first order perturbation theory of Ambegaokar and Baratoff (1963) (Phys. Rev. Lett. 10, 486-9; Phys. Rev. Lett. 11, 104) is generalized in a form, by which all higher order terms can be obtained by an iterative formula. These terms will become important, when the normal conductance of the junction has a magnitude much exceeding $1\Omega^{-1}$. (auth)

22723 VOLTAGE STEPS IN THE CURRENT-INDUCED RESISTIVE STATE OF A SUPERCONDUCTOR. Huebener, R. P.; Gallus, D. E. (Argonne National Lab., IL). Phys. Lett.; 44A: No. 6, 443-444(16 Jul 1973).

Regular voltage steps were observed in microstrips of lead at the onset of current-induced resistive state. All dimensions of the strips are large compared with the superconducting penetration depth and coherence length. (auth)

22724 INFLUENCE OF IMPURITIES ON THE SUPERCONDUCTING TRANSITION TEMPERATURE IN W_3Si-TYPE COMPOUNDS. Izyumov, Yu. A.; Syromyatnikov, V. N. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 35: No. 5, 899-909(1973). (In Russian).

For superconducting compounds of the A_3B type with β-tungsten structure, the Labbe–Friedel chain model is accepted. The effect on the superconducting transition temperature of the interzonal scattering of electrons of both the d–s and d–d types was investigated. In both cases nonmagnetic impurities lead to decrease of T_c with increase of the concentration. The effect on T_c of the change of the electron concentration in the d-zone because of the difference in the valencies of the impurities and the matrix was also studied. The conditions under which increase of T_c because of the impurities is possible were described. The results of the dependence of T_c on the impurity concentration with stipulation of the values of the parameters characterizing the pure superconductors were obtained by numerical solution of the transcendental equations and represented by graphs. (tr-auth)

22725 MEASUREMENT OF SUPERHEATING AND SUPERCOOLING FIELDS OF SUPERCONDUCTING THIN FILMS. Pellan, Y. (Institut National des Sciences Appliquees, Rennes, France); Blot, J.; Pineau, J. C.; Rosenblatt, J. Phys. Lett.; 44A: No. 6, 415-416(16 Jul 1973).

Division of a thin film into an array of small squares allowed the observation of superconducting metastable states. (auth)

Equipment and Devices

Refer also to abstracts 21423, 22170, 22498, 23175, and 23832.

22726 (BNL-18048) SUPERCRITICAL HELIUM FACILITY FOR MEASURING HIGH-VOLTAGE BREAKDOWN. Forsyth, E. B.; Britton, R. B.; Dean, J.; Jensen, J. E.; Minati, K. (Brookhaven National Lab., Upton, N. Y.). [nd]. 17p. (CONF-730805-3). Dep. NTIS $3.00.

From cryogenic engineering conference; Atlanta, Georgia, USA (8 Aug 1973).

The superconducting power transmission cable under development at Brookhaven consists of flexible, concentric coaxial conductors insulated by wrapped dielectric tape. Under operating conditions the insulation will be impregnated by the helium coolant. Thus an important part of the development program is to determine high-voltage breakdown characteristics for a variety of dielectric tapes immersed in a supercritical helium environment. A pressure vessel has been constructed which contains the sample wound on a test mandrel. The mandrel has two stress cones which provide a smooth increase in electric field intensity to maximum value which is maintained along a simulated cable test section which is 60 cm long. The helium is maintained at a constant temperature in the vicinity of the stress cones and test section. The temperature and pressure can be varied within the pressure chamber over the ranges 4.5 to 15 K and 1 to 16×10^5 N/m^2 respectively. The bushing design has a basic insulation level of 150 kV and ac, dc and impulse power supplies are available for testing. (auth)

22727 SUPERCONDUCTING FLUX PUMP. Laquer, H. L.; Carroll, K. J.; Hammell, E. F. (to United States Atomic Energy Commission). Australian Patent 416,494. 23 Aug 1971. Priority date 1 Jun 1966, United States of America (USA).

An improved superconducting flux pump circuit is described comprising first and second parallel superconducting inductances at superconducting temperatures. The first inductance L_1 is of a value substantially greater than the second inductance L_2. Means is also provided for periodically applying voltage pulses of one polarity to the parallel arrangement of inductances whereby the second inductance L_2 is periodically switched by its critical current I_{c2} to its normal resistive state R_2 during a part of such pulses thereby flux pumping the first inductance L_1. (auth)

22728 OPTIMIZATION OF SUPERCONDUCTING MAGNETIC SYSTEMS OF MHD CONVERTERS. Coufal, O. (Inst. of Special Electroenergetics, Brno). Magn. Gidrodin.; No. 4, 115-118(1972). (In Russian).

Two types of iron-free magnetic systems (infinite length) of

homogeneous magnetic fields are known at the present time. One is an elliptical winding, produced by the intersection of two identical parallel elliptical cylinders with equal opposed currents, and the optimal winding whose form was determined by the boundary of the rectangular operating range of the MHD generator, with two step-wise functions and squares in the angle of the working range. The existence was shown of elliptical windings of minimum cross section, making in the rectangular operating range a given homogeneous field. A basic evaluation was made of the inhomogeneous field in the operating range of the optimal winding. The cross section of the optimum winding was compared with the cross section of the elliptical and other windings under the same magnetic induction and cross section of the channel of the MHD generator. The calculation results were used for the determination of the capacity of the superconducting windings of the MHD generator. (tr-auth)

22729 A METHOD FOR PRODUCING LONG, CYLINDRICAL, SUPERCONDUCTING FLUX SHIELDS. Newton, A. C.; Martin, F.; St. Lorant, S. J.; Toner, W. T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Rev. Sci. Instrum. 44: No. 2, 244-245 (Feb 1973).

A technique is described for making long, cylindrical, magnetic flux shields from Nb_3Sn superconducting tape. (auth)

22730 EFFECT OF NONUNIFORM COUPLING ON JUNCTION PARACONDUCTIVITY. Simanek, E.; Walker, P. (Univ. of California, Riverside). Phys. Lett.; 44A: No. 6, 419-420(16 Jul 1973).

The effect of spatial variations of the junction coupling on the excess current–voltage characteristics is studied in the paraconducting regime. A nonlinear increase of the peak voltage $V_{(p)}(\epsilon)$ with ϵ is predicted in agreement with experiments. (auth)

PHYSICS (NUCLEAR)

22731 NUCLEAR PHYSICS AND COSMIC RADIATION. The First 15 Years of the Institute of Pure and Applied Nuclear Physics, University of Kiel. Bagge, E. (Univ., Kiel). Atomkernenergie; 20: No. 3, 166-172(1972). (In German).

A report is given on the foundation, the development and the scientific activities of the institute. (10 figures) (GE)

Neutron Interactions with Matter

Refer also to abstracts 21998, 22002, 23487, and 23973.

22732 (GKSS-73/E/12) TOTAL NEUTRON CROSS SECTION OF THE MOLECULES IN BINARY SOLUTIONS. Suszkin, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

An equation is provided which describes the concentration dependence of the cross section of molecules in binary solutions. Its application is discussed. The theoretical values of the average cross section calculated for some solutions correlate satisfactorily with the experimental values of the molecular cross section obtained from the measurements of the transmission of these solutions for slow neutrons. At the cross section of the solutions studied no influence of the change of the molecular bonding could be seen. (auth)

22733 (RT/FI-(73)11) BOUNDEDNESS, CONTINUITY, POSITIVITY, CONVERGENCE AND SUMMABILITY FOR THE SOLUTION OF THE NEUTRON BOLTZMANN EQUATION IN A MULTI-REGION PROBLEM. Premuda, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 31 Mar 1973. 62p. Dep. NTIS (U. S. Sales Only) $5.25.

This work is an extension to the multi-region plane and spherical geometries of an investigation for homogeneous slabs and spheres. Once the monoenergetic neutron transport integral equation appropriate for the considered geometries are formulated under the assumption of isotropic scattering and fission, a detailed analysis of their kernels is carried out. In both geometries the transport integral transformation, which has a kernel positive almost everywhere and continuous in the mean, is also of finite double norm, continuous, compact and non-singular; when applied to any function of L_2 it gives a bounded function and applied to the latter gives a continuous function. These properties in their whole imply the existence of a dominant eigenfunction bounded, continuous, and positive everywhere in critical conditions; strictly related are the convergence in the mean and the point-wise uniform and absolute convergence of the Neumann series to the positive continuous solution for all subcritical cases. The neutron conservation laws then derived from the integral transport equation allow finally a detailed investigation of the summability for the total fluxes over infinite domains. (auth)

22734 (UCID-16313) STEPS TOWARD IMPORTANCE SAMPLING FOR MCMEG. Loewe, W. E. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Jul 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

The use of prior knowledge to improve Monte Carlo efficiency via importance sampling for the neutron transport code MCMEG is discussed. An algorithm for nonuniform particle allocation is derived. With this method factors of three in running time can be realized. (RWR)

22735 THERMOGENE, AN INTEGRAL TRANSPORT PROGRAM FOR ARBITRARY X–Y GEOMETRY SYSTEMS. 2. Experimental Verification of Calculated Results. Janssen, A. J.; Caspers, L. M. (Interuniversitair Reactor Instituut, Delft, Netherlands). Atomkernenergie; 21: No. 2, 81-91(1973).

Thermal-neutron angle-dependent spectrum and activation measurements in simulated BWR-type box cells are presented as a check on calculated results obtained with THERMOGENE. The measurements show, among other results, that (1) space-dependent reaction rates and local peaking factors are predicted by this program with 2% accuracy, provided the results of both transport model options (as mentioned in part 1 of this paper) are averaged, (2) the complete angular spectrum can be calculated with 3% accuracy with the Koppel–Young model for light water, provided linear anisotropic scattering is assumed for systems with large neutron leakage. The Goldman kernel for polyethene (that was sometimes used as a substitute for water) did give—at locations with large neutron leakage—much larger discrepancies. (16 figures) (auth)

22736 MANY-RESONANCE APPROXIMATION FOR THE NEUTRON ENERGY SPECTRUM. Segev, M. (Soreq Nuclear Research Center, Yavne, Israel). Nucl. Sci. Eng.; 50: No. 4, 354-363 (Apr 1973).

The neutron energy spectrum of fast reactors in the energy range from several keV to several tens of keV is influenced by a multitude of resonances of the fertile and fissile elements. A single elastic scattering in this range distributes the neutrons across many resonances. Since the resonance parameters are randomly distributed about average values, the collision rate below any energy point is the sum of many, uncorrelated, resonant scattering rates above the point; hence, the collision density, as a function of energy, is a smooth curve dominating over small local fluctuations. It is demonstrated, both analytically for simplified cases and numerically for realistic cases, that the deviations from a smooth curve are negligible. In lethargy units, the smooth collision density is $[a(u)/\nu(u)] \exp[-\nu(u)]$. The definitions of the parameters $a(u)$ and $\nu(u)$ involve only average properties of the resonance population, namely the averages over many resonances of the scattering probabilities $s_i \equiv \Sigma$ (scattering, element)/Σ (total, mixture). The average absorption probability is $a(u)$; $\nu(u)$ is given implicitly by the transcendental equation $1 - \nu = \Sigma_i[\langle s_i \rangle/\alpha_i][1 - (1 - \alpha_i)^{1-\nu}]$, where α_i is the maximum relative energy loss per scattering in the i'th element. An accurate solution of the transcendental equation is found most essential for an accurate prediction of integral reaction rates. For this purpose a series solution for ν in terms of $\langle s_i \rangle$ is developed. (1 figure, 4 tables) (auth)

22737 CONDITIONS OF FAST MULTIPLYING SYSTEMS FOR EXISTENCE OF THE TIME EIGENVALUE OF THE FUNDAMENTAL MODE. Hiraoka, T. (Japan Atomic Energy Research Inst., Tokai); Ukai, S. J. Nucl. Sci. Technol. (Tokyo); 10: No. 3, 186-191(Mar 1973).

A few concrete conditions for the existence of the time eigenvalue of fast multiplying systems are derived from the integral transport equation. In order that the real time eigenvalue may exist, there are limitations to the composition and the size of the systems. It may be considered, with very good approximation, that a necessary condition for the existence of the real time eigenvalue is that the infinite multiplication constant is not less than unity. With respect to the size of the system, if half the minimum chord length is not less than three times the inverse of $\{\Sigma_s(v) + \nu\Sigma_f(v)\}_{min}$, the system is not too small for the existence of the real time eigenvalue. These conditions can be applied to the planning and the analysis of pulsed neutron experiments on a fast multiplying system. (auth)

22738 GENERAL THEORY OF ELASTIC MODERATION IN INFINITE HOMOGENEOUS MEDIA. Sengupta, A.; Srikantiah, G. (Indian Inst. of Tech., Kanpur). J. Nucl. Energy; 27: No. 7, 511-517(Jul 1973).

A formula that allows the exact determination of the nontrivial root ξ^* arising in the solution $q(u) = \xi^*(u)F(u)$ to the slowing down equation is given. A general approximation scheme for obtaining approximations to ξ^* is derived. The classical approximations of Fermi and of Greuling and Goertzel are the two lowest order approximations of this scheme. A method of consistent approximation, as opposed to the usual inconsistent method of which the Fermi, and Greuling and Goertzel are particular examples, is also introduced. It is shown that this consistent approach greatly improves on the inconsistent one. A new physical interpretation of ξ^* is discussed. (auth)

22739 DIFFUSION AND EXTRAPOLATION LENGTHS OF THERMAL NEUTRONS IN ORGANIC SUBSTANCES BY A STATIC METHOD. Martinho, E.; Costa Paiva, M. M. (Junta de Energia Nuclear, Sacavem, Portugal). Atomkernenergie; 21: No. 2, 93-98(1973).

Measurements of diffusion and extrapolation lengths of thermal neutrons in several organic substances (benzene, toluene, benzyl alcohol, ethylbenzene, xylene, cumene, diethylbenzene, triethylbenzene, hexane, heptane, cyclohexane, and cyclohexanol) at room temperature by a static method are reported. A uniform plane source of thermal neutrons and a parallelepipedal aluminum container having a buckling of $B^2 = 0.08$ cm^{-2} were used. The diffusion length values obtained are compared with 21 pulsed results of other authors using the macroscopic absorption cross section for 2,200 m s^{-1} neutrons as correlation parameter. It is concluded that a systematic deviation of the order of 7% exists between the results derived from pulsed and static measurements. (5 figures, 3 tables) (auth)

22740 SOLUTION OF THE SLOWING DOWN EQUATION FOR A MIXTURE OF SEVERAL NUCLEI. Menon, S. V. G.; Sahni,

D. C. (Bhabha Atomic Research Centre, Trombay, India). Energ. Nucl. (Milan); 20: No. 7, 400-405(Jul 1973).

A method in which the exact closed form solution of the slowing down equation for the case of a single moderating species, recently obtained by Dawn, can be extended to solve the slowing down equation for an infinite homogeneous mixture of moderating nuclei is studied. The lethargy intervals pertinent to the principal moderator are subdivided into sub-intervals in order to account for the effect of the second moderator. By observing that the kernel of the integral equation is again in the separable form, an exact solution is obtained which is, however, very complicated. As an alternative, therefore, the contribution from the second moderator is treated as a perturbation and the collision density corrected to first order is obtained in a way analogous to that of Dawn. (auth)

22741 POSSIBILITY OF GUIDED-NEUTRON-WAVE PROPAGATION IN THIN FILMS. De Wames, R. E.; Sinha, S. K. (North American Rockwell Science Center, Thousand Oaks, California 91360). Phys. Rev. B 7: No. 3, 917-921 (1 Feb 1973).

The propagation of guided-neutron waves in thin films is discussed and a theory is given for a simple coupling device for exciting such guided-neutron waves by means of neutron beam. The principle is analogous to that used in the construction of optical-prism couplers used to guide laser beams in thin films. The larger divergence of the incident neutron beam drastically lowers the effective coupling efficiency, but the effect should nevertheless be readily observable. A qualitative discussion of Marx's microguide device and its relationship to our problem is also given. (auth)

22742 EXACT SOLUTION OF THE CRITICAL PROBLEM FOR A SLAB BOUNDED BY TWO REFLECTORS FOR LINEAR ANISOTROPIC SCATTERING. Winkler, H. (Univ., Karlsruhe, Ger.). Atomkernenergie; 21: No. 3, 163-173(1973).

The monoenergetic critical problem is solved for a finite homogeneous slab bounded by two infinite homogeneous reflectors. The scattering of neutrons is assumed to be linear anisotropic. By using the spherical harmonics method the critical condition can be calculated in $P_{(L)}$ approximation. In the limit $L \to \infty$ we get an exact equation appropriate to approximate solutions and their numerical calculations. For the exact critical slab thickness lower and upper bounds are derived, which give an estimation for the maximal error of the approximations. (3 figures, 1 table) (auth)

22743 MONTE CARLO CALCULATIONS OF A HYDROGEN COLD NEUTRON SOURCE. Kalli, H. (Helsinki Univ. of Tech., Otaniemi, Finland). Acta Polytech. Scand., Phys. Nucl. Ser.; No. 88, 1-28(1972).

The results of Monte Carlo calculations of a hydrogen cold neutron source in a tangential beam tube configuration are discussed. In the calculations the shape of the cold neutron source was cylindrical with half-spherical ends and its diameter fixed. Its length was optimized. The calculations were performed for hydrogen at two different temperatures: (1) for gaseous hydrogen at 35 K by varying the source length, the pressure and the relative ortho/para abundance, (2) for liquid hydrogen at 20.4 K by varying the source length and the relative ortho/para abundance. In both cases the optimal length was about 40 cm and hence the cold neutron source obtained differed radically from the previous cold neutron sources. Contradictory to some earlier results, parahydrogen was found to be a better cold neutron source material than orthohydrogen. (auth)

22744 NEUTRON TRANSPORT DURING A NUCLEAR AIR BURST DERIVED BY MONTE CARLO CALCULATIONS. Laaksonen, J. (Technical Research Centre of Finland, Otaniemi); Jauho, P.; Kalli, H. Acta Polytech. Scand., Phys. Nucl. Ser.; No. 94, 1-26(1973).

An attempt to determine the energy, space and time distribution of neutrons resulting from an air burst of a nuclear device is described. Calculations have been performed on the UNIVAC 1108, using Fortran V as the programming language. The Monte Carlo coding utilized in this work has been developed by the authors; cross-sections are those of Bondarenko (1964). (auth)

22745 VARIANCE REDUCTION TECHNIQUES IN MONTE CARLO SOLUTIONS OF NEUTRON TRANSPORT PROBLEMS. Kalli, H. (Helsinki Univ. of Tech., Otaniemi, Finland). Acta Polytech. Scand., Phys. Nucl. Ser.; No. 89, 1-27(1972).

The Monte Carlo solution of stationary neutron transport problems is discussed. Recent work on variance reduction is reviewed. The variance reduction techniques are divided into two principal classes. The techniques in the first class are based on non-analog random walk processes designed to reduce the variance of an estimator for single histories. The techniques in the second class are designed to reduce the variance for sets of unindependent histories. The theory of non-analog random walk process techniques is applied to the estimation of neutron flux at a point. A numerical test is performed. (auth)

22746 STUDY OF PULSED EXPERIMENTS IN LATTICES IN A ONE-GROUP DIFFUSION MODE. van Binnebeek, J. J. (Univ., Brussels). J. Nucl. Energy; 27: No. 7, 449-464(Jul 1973).

The decay of a neutron burst in pulsed experiments in lattices is computed in one-group diffusion with respect to the buckling, using a group theoretical theory based on a solid state-like formalism. A transport band structure is obtained and a generalized Nelkin's expansion for the neutron decay is computed for a square water-beryllium lattice with respect to the radius of the central beryllium rod. The influence of the rod nuclear parameter in Nelkin's expansion is also studied. (auth)

22747 MEASUREMENT OF THE MULTIPLICATION FACTOR OF FISSION NEUTRONS IN THE $^{9}Be(n,2n)$ REACTION IN BERYLLIUM AND BERYLLIUM OXIDE BY THE MANGANESE-TANK METHOD. Zhezherun, I. F.; Taraban'ko, V. A. At. Energy. (USSR); 33: No. 5, 914(Nov 1972). (In Russian).

This paper was summarized as paper No. 618/6490 with full copy held by TIC.

The manganese bath technique was used to measure the neutron multiplication factor of the $^{9}Be(n,2n)$ reaction in beryllium and beryllium oxide for fission neutrons. The neutron source was a $^{235}U_3O_8$ converter irradiated in the thermal column of a reactor. (JWR)

22748 SOLUTIONS OF MONOENERGETIC TIME DEPENDENT NEUTRON TRANSPORT EQUATION IN SLAB GEOMETRY. Yamagishi, T. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 5, 284-291(May 1973).

Approximate solutions to the one-velocity time dependent neutron transport equation are derived by means of the eigenfunction expansion method of Case for a slab geometry. A finite set of discrete time eigenvalues is determined by a simple formula. This formula, which is derived for the case of large slab thickness, is found to be valid also for fairly thin slabs. Each time eigenvalue generates a pair of spatial modes. The expansion coefficients to these modes are examined by numerical evaluation for various slab thicknesses. Higher spatial modes are found to play an important role in the transient time evolution of neutrons. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 22510, 22512, 22538, 22636, 22919, 23027, 23071, and 23108.

22749 (CEA-N-1600, pp 82-85) MEASUREMENT OF SPIN CORRELATION COEFFICIENTS IN DEUTERON-PROTON ELASTIC SCATTERING AT 17.4, 19.5, 23.8, and 26.1 MeV. Chauvin, J.; Fruneau, M.; Garreta, D. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971-September 30, 1972.

Spin correlation coefficients were measured for deuteron-proton elastic scattering. The vector and tensor polarized deuteron beam of the Grenoble AVF cyclotron was scattered on a polarized proton target. (auth)

22750 (CEA-N-1600, pp 173-175) LOW-ENERGY PION-NUCLEON SCATTERING. Bertin, P.; Bihoreau, B.; Colin, G.; Coupat, B.; Duclos, J.; Gerard, A.; Isabelle, D.; Magnon, A.; Michel, B.; Miller, J.; Monteret, J. C.; More, J.; Morgenstern, J.; Mouhot, R.; Picard, J.; Vernin, P. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971-September 30, 1972.

The phase shifts occurring in the s and p waves encountered in $\pi^+p \to \pi^+p$ and $\pi^-p \to \pi^-p$ reactions using pions having a small incident energy (20 MeV to 100 MeV) are being measured. A liquid hydrogen target is used. The scattered pion is detected using plastic scintillators and spark chambers which give the angular distribution. (auth)

22751 (FRNC-TH-384) STUDY OF THE GROUND STATE OF ^{3}He BY QUASI-ELASTIC (p,2p) AND (p,pd) SCATTERING AT 155 MeV. Frascaria, R. (Paris Univ., Orsay (France)). 1973. 51p. (In French). Dep. NTIS (U.S. Sales Only) $4.75.

Thesis.

Quasi-elastic $^{3}He(p,2p)$ and $^{3}He(p,pd)p$ reactions at 156 MeV with pp and pd final state interactions respectively were studied. In the pp quasi-elastic zone the residual deuteron has a low momentum (less than 0.7 fm^{-1}). The deuteron can thus be considered as a

spectator in the interaction. The (p,2p) interaction enabled the p-d ($^3S_1$) overlap integral to be obtained for ^{3}He together with that of the quasi-bound p-d ($^1S_0$). The (p,pd) reaction near to the quasi-elastic p-d scattering yields information on the p-d overlap. Measurements of the ^{3}He(p,2p)d cross sections permitted approximations on the description of the mechanisms to be tested. The DWIA formalism was used. In the $0 < k_3 < 0.3$ fm^{-1} zone where the asymptotic part of the function is tested, only the exponential tailed wave functions give good agreement for the form. When $k_3 > 0.3$ fm the ^{3}He proton can no longer be considered free. The absolute magnitudes of the quantities were measured with an accuracy of better than 10%. The distribution of the nucleon momenta are extracted from comparisons made with the DWIA calculation, the normalization uncertainty being less than 15%. (auth)

22752 (JINR-P15-7121) STUDY OF THE REACTION ^{2}H(^{3}He,p)^{4}He. Abuzeid, M.; Osetinskii, G. M.; Tyke, Ya.; Fryshchin, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The angular distributions and excitation functions of the reaction ^{2}H(^{3}He,p)^{4}He were measured using a thin gas target in the energy range 1.4 to 4.4 MeV. The integrated cross sections of the reaction were calculated. The measurement error for differential cross sections does not exceed 3%, for total ones it is about 4%. (3 figures, 2 tables) (auth)

22753 (LBL-1666, pp 55-56) VECTOR ANALYZING POWER IN $\vec{d}$-^{4}He ELASTIC SCATTERING BETWEEN 15 AND 45 MeV. Conzett, H. E.; Dahme, W.; Leemann, C.; Macdonald, J. A.; Meulders, J. P. May 1973.

In nuclear chemistry annual report, 1972.

22754 (LBL-1666, pp 57-58) DEVIATIONS FROM THE BARSHAY-TEMMER SYMMETRY IN THE REACTION ^{4}He($\vec{d}$,t)^{3}He. Dahme, W.; Arvieux, J.; Birchall, J.; Conzett, H. E.; Larimer, R. M. May 1973.

In nuclear chemistry annual report, 1972.

22755 (LBL-1666, pp 58-59) ^{4}He($\vec{p}$,d)^{3}He REACTION BETWEEN 32 AND 53 MeV. Sagle, A.; Bonner, B. E.; Broste, W. E.; Conzett, H. E.; Dahme, W.; King, N. S. P.; Leemann, C. May 1973.

In nuclear chemistry annual report, 1972.

22756 (LBL-1666, pp 59-61) VECTOR ANALYZING POWER IN ELASTIC DEUTERON-DEUTERON SCATTERING BETWEEN 20 AND 40 MeV. Conzett, H. E.; Dahme, W.; Larimer, R. M.; Leemann, C.; McKee, J. S. C. May 1973.

In nuclear chemistry annual report, 1972.

22757 COUPLING CONSTANT AND FORM FACTOR FOR THE T IN EQUILIBRIUM D + N VERTEX. Orlov, Yu. V.; Belyaev, V. B. (Moscow State Univ). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 276-279(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 385-389(5 Apr 1973).

It has been observed that the coupling constant G_t^2 for the $t \rightleftharpoons d + n$ vertex is very sensitive to the form of the NN potential; this can be used to select NN interactions that agree with the results of the analysis of nuclear reactions and scattering by light nuclei. (auth)

22758 PION PRODUCTION BY 600-MeV PROTONS ON LIGHT NUCLEI. Eisenberg, J. M.; Guy, R.; Noble, J. V.; Weber, H. J. (Univ. of Virginia, Charlottesville). Phys. Lett.; 45B: No. 2, 93-95(9 Jul 1973).

The forward cross section at $E_p = 600$ MeV is calculated for the reaction $p + (N, Z) \rightarrow (N + 1)^* + \pi^+$ using a single-nucleon mechanism, distorted pion and proton wave functions and bound-state nucleon wave functions with realistic asymptotic behavior. Good agreement with experiment is found for ^{4}He, ^{12}C, and ^{14}N. (auth)

22759 LONGITUDINAL POLARIZATION TRANSFER IN THE D($\vec{d}$, $\vec{n}$)^{3}He REACTION AT 0°. Salzman, G. C. (Los Alamos Scientific Lab., NM); Martin, J. C.; Jarmer, J. J.; Simmons, J. E.; Ohlsen, G. G.; Donoghue, T. R. Phys. Lett.; 45B: No. 2, 123-126 (9 Jul 1973).

The longitudinal neutron polarization was measured in the D($\vec{d}$, $\vec{n}$)^{3}He reaction, at $\theta = 0°$, for an incident longitudinally polarized deuteron beam. A deuteron energy range of 3.3 to 14.9 MeV was covered. The polarization transfer from the deuteron to the neutron is found to be large, and the reaction is potentially useful as a source of polarized neutrons. (auth)

22760 THREE-PARTICLE SYSTEM AND ACCURACY OF THE BRUECKNER THEORY FOR LIGHT NUCLEI. Sotona, M. (Inst. of Nuclear Physics, Rez, Czech.). Lett. Nuovo Cim.; 17: No. 12, 523-527(21 Jul 1973).

The three-body problem is solved by using the Brueckner theory with the aim of obtaining information on the Brueckner-Goldstone expansion and on its applicability for the calculation of binding energies of light nuclei. The reaction matrix calculation is performed on the basis of single-particle functions of a modified harmonic oscillator Hamiltonian, and nonlocal separable potentials are used. The ^{3}H binding energy and second-order corrections are given for several potentials and different models. The oscillator length is found to be between 1.5 and 1.7 fm. The results obtained show that for ^{3}H and apparently for other light nuclei the Brueckner theory with commonly used approximations yields the binding energies with accuracy of about 5%. Extraordinary attention must be paid, however, to the problem of the exclusion of c.m. motion. The application, from the beginning, of the intrinsic Hamiltonian and a suitable modification of the whole reaction matrix calculation appears to be the most consistent procedure. (2 figures, 1 table) (RWR)

22761 TENSOR PART IN SEPARABLE POTENTIALS. Urban, P.; Crepinsek, L.; Faustmann, H. J.; Lambacher, H.; Oberhummer, H.; Zingl, H. F. K. (Univ., Graz). Acta Phys. Austr.; 37: No. 3, 245-253(1973). (In German).

With the observation that the Yamaguchi tensor potential cannot describe even the simplest polarization phenomenon in the n-p case as a basis, a higher rank separable potential including a tensor part is proposed; and calculations of ^{3}S-^{3}D n-p scattering and deuteron data as well as of the contribution to nuclear matter energy are performed. A reasonable agreement with experimental data is stated. (3 figures, 2 tables) (auth)

22762 NUCLEI OF LIGHT ELEMENTS WITH A NEUTRON EXCESS OBTAINED IN TRANSFER REACTIONS WITH HEAVY IONS. Volkov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 285-313 (1971). (In Russian).

The production methods of light nuclei with large neutron excess were considered. It was shown that up to the present time multinucleon transfer reactions with heavy ions are the most effective method. The new method of identification of transfer reaction products was considered. The problem of nucleon stability boundary for light neutron rich nuclei is discussed. (auth)

22763 THREE-BODY NUCLEAR PROBLEM. Belyaev, V. B. (Joint Inst. for Nuclear Research, Dubna, USSR); Vzhetsionko, E. Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 415-437(1971). (In Russian).

This review contains an exposition of regular methods of calculating the characteristics of 3-nucleon systems with local potentials and an analysis of results obtained by these methods. Only results of calculations of the tritium binding energy and the doublet nd-scattering length are considered. The problem of the nonuniqueness in the choice of the form and parameters of the nucleon-nucleon interaction is discussed. (auth)

22764 PERIPHERAL MODEL APPROACH TO THE PROCESS OF RADIATIVE PROTRON CAPTURE BY TRITIUM. Baryshnickov, A. G.; Blokhintsev, L. D.; Mukhamedzhanov, A. M.; Turovtsev, V. V. (Moscow State Univ.). Phys. Lett.; 45B; No. 1, 1-3(25 Jun 1973).

Within the framework of the direct reaction peripheral model the differential cross section for the reaction ^{3}H(p,γ)^{4}He at $E_p = 156$ MeV is calculated. The theoretical angular distribution is in good agreement with the experimental one and the obtained value of the coupling constant of the nuclear vertex $^3H + p \rightarrow {}^4$He is close to the results of previous works. (auth)

22765 N-d BACKWARD SCATTERING AND VIRTUAL STATES OF THE TRINUCLEON. Brady, T. J. (Univ. of Maryland, College Park). Phys. Lett.; 45B: No. 1, 4-6(25 Jun 1973).

The 180° nucleon-deuteron elastic cross section exhibits a peak as a function of nucleon energy which has been interpreted as due to a virtual state of the trinucleon. This interpretation is examined within the context of the Amado model. (auth)

22766 SELF-CONSISTENT CENTER-OF-MASS CORRECTION AND THE CHARGE FORM FACTOR OF ^{4}He. Boffi, S.; Pacati, F. D. (Univ., Pavia, Italy). Nucl. Phys.; A210: No. 3, 477-488(1973).

The Hartree-Fock approximation is used for ^{4}He in the case of Lipkin's Hamiltonian with several nuclear forces. The self-consistent solution practically coincides with the one obtained in the usual HF method applied to the intrinsic Hamiltonian; however, the center of mass is now in its ground state, and its motion is fairly separated in the ground state function of the nucleus. An unambiguous comparison between experimental and theoretical charge form factor is done. The discrepancies cannot be interpreted as due to spurious c.m. effects. (auth)

22767 POSITIVE-PION PHOTOPRODUCTION FROM ^{3}He NUCLEI. Lazard, C. (Institut de Physique Nucleaire, Orsay, France); Maric, Z. Nuovo Cim.; 16A: No. 4, 605-623(21 Aug 1973).

The pion photoproduction from three-body nuclei in the energy region of the first pion-nucleon resonance is calculated in the impulse approximation, including an estimation of the rescattering terms, and compared to recent experimental results. It is shown that the proper kinematics and the inclusion of the S′ and D states into the three-body nuclear wave function explains fairly well the position of the pion-nucleus resonance and the behavior of the cross section at fixed momentum transfer for the whole investigated region. The calculations are performed for several types of nuclear wave functions. The results are sensitive to the value of the D-state radius. The stability of the calculated curves with respect to the choice of the amplitude for the pion photoproduction on nucleon is tested. At fixed angle, the measured cross section disagrees with the bare impulse approximation calculations for higher values of the momentum transfer. In this case, the influence of the rescattering terms is discussed. (auth)

22768 INTRODUCTIONS OF 9.4 GeV/c DEUTERONS IN AN EMULSION: MULTIPLICITY AND ANGULAR DISTRIBUTIONS. Galstyan, Ya. A. (Inst. of Physics, Erevan); Lepekhin, F. G.; Simonov, B. B.; Perfilov, N. A.; Solovieva, Z. I.; Fadina, E. V.; Bogacev, N. P.; Tolstov, K. D.; Shabratova, G. S.; Azimov, S. A.; Basova, E.; Pietrov, V. I.; Tchernov, G. M.; Gulyamov, U. G.; Doroba, K.; Jacholkowski, A.; Skrzypczak, E. Nucl. Phys.; A208: 626-636(1973).

An analysis of 1650 stars induced by 9.4 GeV/c deuterons in a nuclear emulsion is presented. Multiplicity and angular distributions of secondaries are discussed. (auth)

22769 CROSS SECTION RATIO OF THE REACTIONS ^{4}He(γ,p)^{3}H AND ^{4}He(γ,n)^{3}He IN THE REGION OF GIANT RESONANCE, AND CHARGE SYMMETRY. Arkatov, Yu. M.; Vatset, P. I.; Voloshchuk, V. I.; Zolenko, V. A.; Prokhorets, I. M.; Khodyachikh, A. F.; Chmil', V. I. (Physical Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 253-255 (5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 356-358(5 Mar 1973).

The cross sections for both reactions were determined under identical conditions with good statistics, in the energy range 24 to 120 MeV for the (γ,n) reaction and from threshold to 120 MeV for the (γ,p) reaction. Excitation functions are shown for the interval from 20 to 52 MeV; they agree well with each other. This is to be contrasted with some of the previously published work, where the ratio was 2. It is concluded that the fact that the ratio in the present work differs insignificantly from unity can be attributed to a number of factors not connected with violation of the charge symmetry of the nuclear forces. (2 figures) (RWR)

22770 NEUTRON PRODUCTION CROSS SECTIONS AND ENERGIES FOR THE REACTIONS T(p,n)^{3}He, D(d,n)^{3}He, AND T(d,n)^{4}He. Liskien, H.; Paulsen, A. (Joint Nuclear Research Center, Geel, Belg.). Nucl. Data, Sect. A; 11: No. 7, 569-619 (Jun 1973).

Center-of-mass best values for the normalized Legendre-coefficients and the 0° differential cross section as functions of input energy were derived from various experimental results for the reactions T(p,n)^{3}He, D(d,n)^{3}He, and T(d,n)^{4}He. This information was used to calculate laboratory differential cross sections as functions of laboratory input energy and neutron emission angle, which are given in tabular form with the corresponding neutron energy. (13 figures, 34 tables) (auth)

22771 TRITON BINDING ENERGY FOR THE REID POTENTIAL. Hennell, M. A.; Delves, L. M. (Univ. of Liverpool). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 103-107(1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

Preliminary results of a variational calculation of the triton binding energy for the REID potential are presented. These results are compared with those of the Hamada–Johnston and Gammel–Bruchner potentials. Comparison is also made with the results of Malfliet and Tjon. (auth)

22772 BINDING ENERGY OF ^{3}H AND n–d DOUBLET SCATTERING LENGTH WITH CHARGE-DEPENDENT FORCES. Dabrowski, J. (Inst. for Nuclear Research, Warsaw). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 129-133(1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

The relation between the triton binding energy (E_3) and the doublet n–d scattering length ^2a is discussed. It is shown that the interpretation of the experimental data is an open question even if one assumes charge dependent forces. (auth)

22773 HOW CAN WE DETERMINE THE TWO-BODY t-MATRIX. Levinger, J. S. (Rensselaer Polytechnic Inst., Troy, NY). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 135-150 (1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

One starts with an assumed shape for the wave function of the ground state of the two-nucleon system. This wave function gives the residue of the t-matrix at the bound-state pole and using the unitary pole approximation (UPA) provides a good extrapolation procedure for other off-shell values of the t-matrix. (E. Harms has verified the accuracy of the UPA using the anti-bound state for the Reid soft-core singlet potential.) One now faces the problem: what bound-state wave function should be assumed? In the next several years it should be possible to determine the deuteron wave function experimentally, by measuring elastic electron-deuteron scattering from polarized deuterons, or equivalently by measuring the polarization of the recoil deuteron. (The wave function at large neutron-proton separation should also be checked by using it in the Schrödinger equation to give a local potential which should agree well with that for one pion exchange.) Angular distribution measurements provide a separation of the deuteron form factor into a charge form factor and a magnetic moment form factor. Polarization measurements separate the charge form factor into a monopole form factor G_0 and a quadrupole form factor G_2. T. Brady has found that values of $G_2(q)$ at momentum transfers q of order 3 F^{-1} are quite sensitive to the percentage of D-state (p_D) in the deuteron. At present the lack of knowledge of p_D is the main source of uncertainty in calculation of the energy of the trinucleon. (auth)

22774 ELASTIC SCATTERING OF ELECTRONS BY DEUTERONS IN THE FRAMEWORK OF THE SOURCE THEORY BY J. SCHWINGER. Goeritz, G. H.; Passler, K. H.; Sauer, G.; Zint, P. G. (Univ., Giessen, Ger.). Z. Phys.; 260: No. 4, 325-328(1973).

Cross sections of the elastic scattering of electrons from deuterons are calculated with the concept of primitive interaction, disregarding the form factors of the deuteron. Formulas are derived for the various possibilities of the electron and deuteron polarization. Numerical results are given for 175 MeV scattering in the rest frame. (2 figures) (auth)

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Refer also to abstracts 22401, 22524, 22624, 22646, 22650, 22758, 22762, 22768, 22834, 22835, 22845, 22858, 22919, 22954, 22955, 23071, 23079, 23085, 23142, and 23262.

22775 (CEA-N-1600) NUCLEAR PHYSICS DEPARTMENT ANNUAL PROGRESS REPORT, OCTOBER 15, 1971–SEPTEMBER 30, 1972. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 273p. (In French). Dep. NTIS (U. S. Sales Only) $15.75.

The experiments and technological studies carried out in the Nuclear Physics Department during the previous year are presented: tandem accelerator studies (reactions induced by heavy-ion beams); high-resolution spectroscopy with the cyclotron; high-resolution spectroscopy using Saturne and 1-GeV protons; results obtained with the 600-MeV linear accelerator; study of giant nuclear resonances on the 60-MeV linear accelerator; fission studies with AL60 and EL3. (FR)

For abstracts of individual papers see: 21342–21344, 22165, 22166, 22176, 22177, 22202–22209, 22512, 22749, 22750, 22776–22786, 22835–22837, 22863–22868, 22891, 22910–22918, 22987, 22988, 23006–23009, 23045, and 23046.

22776 (CEA-N-1600, pp 11-12) QUANTITATIVE STUDY OF TRANSFER REACTIONS INDUCED BY Li IONS. Bassani, G.; DeVries, R. M.; Foti, A.; Pappalardo, G.; Saunier, N. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The cross section data obtained for (^{6}Li,d) and (^{6}Li,t) reactions on ^{11}B, ^{12}C and ^{13}C are analyzed using the hypothesis of the compound nucleus and the direct transfer of a single cluster (DWBA). The DWBA calculations are made using spectroscopic amplitudes deduced from the wave functions of Zuker, Buck, and McGrory. (FR)

22777 (CEA-N-1600, pp 12-13) $^{11}B(^{6}Li,t)^{14}N$ REACTION. Bassani, G.; Foti, A.; Pappalardo, G.; Saunier, N.; Strazzeri, A. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Angular distributions obtained at E_l = 28 MeV are given. The data are currently being analyzed. (auth)

22778 (CEA-N-1600, pp 14-15) EXPERIMENTAL STUDY OF TRANSFER REACTIONS INDUCED BY ^{6}Li ON GASEOUS TARGETS. Bassani, G.; Cunsolo, A.; Foti, A.; Gerardin, C.; Lepareux, M.; Pappalardo, G.; Saunier, N.; Strazzeri, A.; Wery, M. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Reactions induced on gaseous targets (^{14}N, ^{15}N, ^{16}O, ^{20}Ne) by ^{6}Li at E_l = 30 MeV were studied. Some preliminary results are presented. (auth)

22779 (CEA-N-1600, pp 17-18) EFFECT OF PROJECTILE SIZE ON THE CALCULATION OF THE CROSS SECTION FOR THE ELASTIC SCATTERING OF HEAVY IONS. Charles, P.; Dost, M.; Fernandez, B.; Gastebois, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The finite size of the ^{16}O ion is taken into account in a calculation of the real part of the $^{12}C-^{16}O$ optical potential in which an effective ^{12}C–nucleon interaction is folded with the matter distribution of ^{16}O. It is shown that such a potential is able to fit angular distributions over the full angular range and for different energies. (auth)

22780 (CEA-N-1600, pp 22-24) TRANSFER OF EIGHT NUCLEONS IN THE REACTION (^{14}N, ^{6}Li) ON ^{12}C AND ^{16}O TARGETS. Conjeaud, M.; Da Silveira, E.; Gaillard, P.; Harar, S.; Volant, C. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Study of (^{14}N,^{6}Li) on ^{12}C and ^{16}O has continued. Angular distributions were measured for the $^{16}O(^{14}N,^{6}Li)^{24}Mg$ reaction up to 140° in the center-of-mass system. Nuclear structures for some ^{20}Ne and ^{24}Mg levels are discussed by means of comparison between excitations of same states through four- and eight-nucleon transfer. (2 figures) (auth)

22781 (CEA-N-1600, pp 87-91) INELASTIC SCATTERING OF 24.5-MeV POLARIZED PROTONS BY ^{18}O. Escudie, J. L.; Gosset, J.; Lombard, R. M.; Mayer, B.; Pignanelli, M.; Resmini, F.; Tarrats, A. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Experimental results of (p,p′) scattering with polarized protons on ^{18}O are reported. Deformation parameters for low-lying states were deduced using the collective model. A microscopic analysis was attempted using a nucleon–nucleon effective interaction derived using the Kuo–Brown method. (auth)

22782 (CEA-N-1600, pp 92-94) SEVERAL-NUCLEON EXCHANGE IN REACTIONS INDUCED ON ^{7}Li BY A 36-MeV BEAM OF ^{3}He. Bruge, G.; Chaumeaux, A.; DeVries, R.; Leleux, P. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Complete angular distributions were obtained for the reactions $^{7}Li(^{3}He,\alpha)^{6}Li$, $^{7}Li(^{3}He,^{3}He)^{7}Li$, and $^{7}Li(^{3}He,t)^{7}Be$ by measuring Z = 1, 2, 3 or 4 particles in the usual ΔE–E telescope arrangement, self-supporting ^{7}Li targets being used. All the reactions are found to be both forward and backward peaked, indicating the presence of multinucleon transfer processes. The data are being analyzed with an exact finite range DWBA code which allows two reaction mechanisms to be coherently added. (auth)

22783 (CEA-N-1600, pp 94-95) $^{11}B(^{3}He,^{7}Be)^{7}Li$ REACTION CONSIDERED AS A TEST OF THE ONE-α-PARTICLE-TRANSFER REACTION MECHANISM. Bruge, G.; Chaumeaux, A.; DeVries, R.; Leleux, P. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The angular distribution of the $^{11}B(^{3}He,^{7}Be)^{7}Li$ reaction from an enriched ^{11}B target was studied using a 36-MeV ^{3}He beam. Two direct reaction mechanisms contribute. The strong forward peaking (observed as a function of the scattered ^{7}Be angle) is attributed to the J = 0, T = 0 α transfer reaction mechanism. The forward ^{7}Li angle (backward angle for ^{7}Be) cross section is very large and may be attributed to a T = 1 (3n,1p) transfer. These reaction mechanisms are being calculated using finite-range DWBA and coherently added to study the relative importance of T = 0 and T = 1 four-nucleon transfer reactions. (auth)

22784 (CEA-N-1600, pp 116-120) SCATTERING OF 1-GeV PROTONS ON ^{12}C, ^{58}Ni, AND ^{208}Pb. Bertini, R.; Beurtey, R.; Brochard, F.; Bruge, G.; Catz, H.; Chaumeaux, A.; Durand, J. M.; Faivre, J. C.; Fontaine, J. M.; Garreta, D.; Gustafsson, C.; Hendrie, D.; Hibou, F.; Legrand, D.; Saudinos, J.; Thirion, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The angular distributions for the elastic and inelastic scattering of 1040-MeV protons by ^{12}C, ^{58}Ni, ^{208}Pb are presented. Up to now no final analysis has been done, but the diffraction pattern in the nickel and lead cases is very clear. (auth)

22785 (CEA-N-1600, pp 167-170) STUDY OF (e,e′p) REACTIONS ON ^{12}C, ^{28}Si, ^{40}Ca, AND ^{58}Ni. Bussiere, A.; Dupont, J.; Mougey, J.; Phan Xuan Ho; Priou, M.; Royer, D.; Sick, I. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

(e,e′p) reactions on ^{12}C, ^{28}Si, ^{40}Ca, and ^{58}Ni were carried out in the 0 to 80 MeV missing energy range, and 0 to 280 MeV/c initial proton momentum range. Momentum distributions were obtained from the data. Distortion effects seem to be of minor importance in the outer shells. (auth)

22786 (CEA-N-1600, pp 170-171) $^{6}Li(e,e'X)$ EXPERIMENTS. Bianchi, G.; Duval, P.; Genin, J. P.; Julien, J.; Letourneau, R.; Mougeot, A.; Rambaut, M.; Roussel, L.; Samour, C.; Vinciguerra, D. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Coincidence experiments of the type (e,e′X), where X is a proton, a deuteron, or an alpha particle, were carried out using two magnetic spectrometers. Heavy particles were detected using solid state counters. It was possible to obtain the momentum distribution for deuterons and alpha particles, the q values being respectively 1.33 and 1.49 fm^{-1}. (auth)

22787 (CONF-730312-(P1), pp 287-323) MULTI-NUCLEON TRANSFER. Fortune, H. T. (Univ. of Pennsylvania, Philadelphia). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

Recent developments in four- and eight-nucleon transfer experiments are summarized, with special emphasis on reactions leading to ^{20}Ne. (auth)

22788 (CONF-730312-(P2), pp 459-464) INTERFERENCE EFFECTS IN THE INELASTIC SCATTERING OF ^{16}O ON ^{17}O AND ^{18}O. Braun-Munzinger, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Gelbke, C. K.; Grochulski, W.; Harney, H. L.; Stock, R. Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Experimental evidence is shown for interference effects in the inelastic scattering of ^{16}O on ^{18}O leading to the first excited $\frac{1}{2}^+$, 0.871-MeV state in ^{17}O and the 2^+, 1.98-MeV state in ^{18}O, respectively. (LTW)

22789 (CONF-730312-(P2), pp 503-508) SPECTROSCOPY OF ^{19}F USING ELASTIC TRANSFER. Gamp, A.; Bohlen, H. G.; Feil, M.; Marquardt, N.; von Oertzen, W.; Walter, R. L. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The elastic scattering of ^{19}F on ^{16}O and ^{18}O and ^{15}N on ^{19}F was studied at several energies ranging from 1 to 5 MeV above the Coulomb barrier with the Heidelberg EN Tandem. Proportional counter telescopes were used in the scattering of ^{19}F on ^{16}O and of ^{15}N on ^{19}F, which gave complete identification of the reaction products. Targets in these cases were SiO_2 for ^{16}O and LiF deposited on ^{12}C for ^{19}F. For the scattering of ^{19}F on ^{18}O, NiO targets were used with approximately 60% ^{18}O and 40% ^{16}O content. For the separation of ^{16}O from ^{18}O kinematical coincidences in combination with the ΔE-E telescope were applied. In this way also the separation of mass ^{19}F from mass ^{18}O was easily achieved with large solid angles due to the measurement of the energy loss. The combination of the two methods was actually necessary for the lower energies because the straggling in the target did not allow sufficiently good angular resolution (however sufficient to separate mass 18 from mass 16) to separate mass 18 from mass 19. (auth)

22790 (CONF-730312-(P2), pp 613-621) DIRECT TRANSFER OR INTERMEDIATE STRUCTURE IN THE INTERACTION OF ^{14}N

WITH ^{10}B? Marquardt, N.; L'Ecuyer, J.; Cardinal, C.; Volders, R. (Univ. of Montreal). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

A preferential excitation of all band members with alternating natural and unnatural parity of the $K^\pi = 2^-$ band in ^{20}Ne has been observed in the reaction $^{10}B(^{14}N,\alpha)^{20}Ne$. Angular distributions of several final states were measured at bombarding energies of 25 and 35 MeV. The results of this experiment are in contrast to the $^{12}C(^{12}C,\alpha)^{20}Ne$ reaction which populates the same compound nucleus, ^{24}Mg, at about the same excitation energy. Comparison with an earlier study of the $^{12}C(^{14}N,^6Li)^{20}Ne$ reaction leading also to ^{20}Ne suggests that an appreciable direct amplitude might be responsible for the selectivity of this transfer. However, an explanation in terms of intermediate structure in the continuum of the highly excited ^{24}Mg compound nucleus cannot be excluded. (auth)

22791 (CONF-730312-(P2), pp 623-628) (^{10}B, ^7Li) AND (^{10}B, ^7Be) ANALOGUE REACTIONS ON ^{12}C. Nagatani, K.; Youngblood, D. H.; Kenefick, R.; Bronson, J. D. (Texas A and M Univ., College Station). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The reactions $^{12}C(^{10}B,^7Li)^{15}O$ and $^{12}C(^{10}B,^7Be)^{15}N$ were investigated using a 100-MeV incident beam from the TAMU cyclotron. These two analog reactions should show almost identical features, since the energies are much higher than the Coulomb barrier involved and the Q-value difference is small, i.e., −5.715 MeV and −3.817 MeV for $^{12}C(^{10}B,^7Li)^{15}O$ and $^{12}C(^{10}B,^7Be)^{15}N$, respectively. Typical spectra for the two reactions taken simultaneously are shown. The angular distributions of the strong peaks are shown, with the distributions for analog states displayed together for comparison. The angular distributions for corresponding states are identical. If incident energies are sufficiently high so that Coulomb effects are negligible, this procedure for identification of analog states should be independent of the reaction mechanism. In this way, pairs in ^{15}O and ^{15}N, respectively, at 9.64 and 9.87 MeV, 10.47 and 10.78 MeV, 12.89 and 13.15 MeV, 15.36 and 15.72 MeV, and 15.88 and 16.26 MeV were identified. (LTW)

22792 (CONF-730312-(P2), pp 689-695) REACTIONS INITIATED BY 100-MeV ^{10}B IONS ON ^{12}C. Youngblood, D. H.; Nagatani, K.; Kenefick, R.; Bronson, J. D. (Texas A and M Univ., College Station). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The Texas A and M Cyclotron Facility is briefly described, and some typical data are given on the reactions induced by ^{10}B ions on ^{12}C. (LTW)

22793 (COO-1717-4) STUDY OF THE STRUCTURE OF ^{12}B VIA ELASTIC SCATTERING OF NEUTRONS FROM ^{11}B. Nelson, C. E. (Ohio Univ., Athens (USA). John E. Edwards Accelerator Lab.). 9 Jun 1973. Contract AT(11-1)-1717. 152p. Dep. NTIS $9.75.

Neutrons in the energy range from 2 to 5 MeV were scattered from a B target. Angular distribution coefficients were found as a function of the incident energy. A two-channel, three-level R-matrix analysis of the data was carried out for levels in ^{12}B with excitations between 5.3 and 7.5 MeV; spins and parities are given. Shell-model calculations were also performed. Predictions of the polarization in the energy interval from 2.2 to 4.5 MeV were made. (34 figures, 4 tables) (RWR)

22794 (COO-1717-5) STUDY OF THE STRUCTURE OF ^{11}B FROM ELASTIC SCATTERING OF NEUTRONS FROM ^{10}B. (Ohio Univ., Athens (USA). John E. Edwards Accelerator Lab.). Hausladen, S. L. 9 Jun 1973. Contract AT(11-1)-1717. 121p. Dep. NTIS $8.25.

Time-of-flight techniques were used to measure the elastic scattering of neutrons from ^{10}B at 1.5 to 4.4 MeV. An improved R-matrix analysis of the data was performed to gain information on the structure of ^{11}B. (JWR)

22795 (FRNC-TH-380) SPECTROSCOPIC STUDY OF ^{18}F USING $^{17}O(p,p)^{17}O$, $^{17}O(p,\alpha)^{14}N$, AND $^{17}O(p,\gamma)^{18}F$ REACTIONS. Sens, J. C. (Strasbourg Univ. (France). Faculte des Sciences). 1971. 127p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Excited levels of the ^{18}O nucleus were studied in the 6 to 7 MeV energy range by observing reactions induced by protons on the ^{17}O nucleus. It was possible to determine the angular momenta, the parities and the electromagnetic transition de-excitation modes of the resonant levels. Information was also obtained on the dominant configurations of highly excited states. Studies of the resonant scattering $^{17}O(p,p)^{17}O$ enabled the orbital momenta of the proton capture to be established. The $^{17}O(p,\alpha_0)^{14}N$ reaction, subjected to an isobaric spin selection rule, was investigated in order to determine the isospin purity of these levels accurately. Studies of $^{17}O(p,\gamma)^{18}F$ radioactive capture permitted the properties of the electromagnetic emission (decay schemes, angular distributions) to be established and a definition to be obtained for certain multipole mixtures. $\gamma\gamma$ angular correlation measurements were effected. The Doppler attenuation method was used to determine the upper limit of the mean lives of the resonant states. The preferential de-excitation mode is the magnetic dipole mode with changes in isobaric spin. The collection of results agrees well with predictions made using the shell model with weak coupling. The existence was established of four states having a T = 1 character for ^{18}O. Information was also obtained on the analogue state of the 5.52-MeV energy state of ^{18}O. (FR)

22796 (FRNC-TH-386) SELECTIVITY OF ONE-NUCLEON AND TWO NUCLEON TRANSFER REACTIONS INDUCED BY HEAVY IONS. Pougheon, F. R. (Paris Univ., Orsay (France)). 1973. 103p. (In French). Dep. NTIS (U.S. Sales Only) $7.25.

Thesis.

Stripping and pick-up involving one or two nucleons were studied for reactions between ^{12}C, ^{13}C, ^{24}Mg, ^{54}Fe, ^{58}Ni target nuclei and 80 MeV ^{16}O and ^{14}N beams. The characteristics of the angular momenta were deduced from the shell model, the ion trajectories and internal motions being treated classically. Two adaptation conditions for the angular momenta were deduced: the conservation of the individual velocities of the transferred nucleons selections the orbital angular momentum of the shell into which the nucleons will enter; the conservation of the total angular momentum fixes the total spin of the level for a given excitation energy. For the preferential population of a level, the two conditions must be fulfilled. In this way, the total spin, the energy, and the configuration of the level are determined. In the case of the transfer of a nucleon, a selection rule governing the spin of the final nucleus explains, in addition, the dependence of the observed cross sections on j. Three new groups of analog isobaric levels T = 1 were localized for ^{58}Ni and ^{60}Zn by comparison with (^{16}O, ^{14}N) and (^{16}O, ^{14}C) spectra obtained with the same targets. (auth)

22797 (JINR-P15-7156) STUDY OF THE REACTION ^{15}N $(^3He,d_0)^{16}O$. Osetinskii, G. M.; Tyke, Ya.; Fryshchin, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The angular distributions and differential cross sections (at 45, 90, and 135°) were measured for the reaction $^{15}N(^3He,d_0)^{16}O$ in the energy range 2.3 to 4.1 MeV using the JINR electrostatic generator. The experimental data are well described in terms of the distorted-wave Born approximation (DWBA) taking into account the contribution of the compound nucleus mechanism by Hauser–Feshbach method. The applicability of the (DWBA) method was studied for the case of error in the orbital momenta for the input and output channels of the reaction. (auth)

22798 (LBL-1666, pp 61-63) ($\vec{d}$,^{3}He) AND ($\vec{d}$,t) REACTIONS INDUCED BY POLARIZED DEUTERONS. Mayer, B.; Conzett, H. E.; Dahme, W.; Kovar, D. G.; Larimer, R. M.; Leemann, C. May 1973.

In nuclear chemistry annual report, 1972.

22799 (LBL-1666, pp 67-70) ANALYZING POWERS FOR ($\vec{p}$,t) AND ($\vec{p}$, ^{3}He) REACTIONS ON ^{12}C. Macdonald, J. A.; Harney, H. L.; Cerny, J.; Bacher, A. D. May 1973.

In nuclear chemistry annual report, 1972.

22800 (LBL-1666, pp 70-71) SOLAR-NEUTRINO PROBLEM: A SEARCH FOR A NARROW STATE NEAR 15.8-MeV EXCITATION IN ^8Li USING THE $\alpha(\tau,p)^8Li$ REACTION. Jelley, N. A.; Arvieux, J.; Weisenmiller, R. B.; Wilcox, K. H.; Wozniak, G. J.; Cerny, J. May 1973.

In nuclear chemistry annual report, 1972.

22801 (LBL-1666, pp 76-77) MASS AND ENERGY LEVELS OF ^{17}Ne FROM THE $^{20}Ne(^6He,^8He)^{17}Ne$ REACTION. Wozniak, G. J.; Mendelson, R. A. Jr.; Loiseaux, J. M.; Cerny, J. May 1973.

In nuclear chemistry annual report, 1972.

22802 (ORNL-4799) CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY 61-, 39-, AND 29-MeV PROTONS ON CARBON AND OXYGEN. Bertrand, F. E.; Peelle, R. W. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 109p. Dep. NTIS $5.45.

Tabulated differential cross sections are presented for proton,

deuteron, triton, helium-3, and alpha particles produced in reactions of 61-, 39-, and 29-MeV protons with carbon and oxygen. Observations with energy resolution as fine as 200 keV were made at 2, 5, and 19 angles, respectively, for carbon and at 1, 4, and 18 angles for oxygen. Spectra are given in bins 1 to 5 MeV wide for energies above a cutoff of 2 to 6 MeV which is dependent on particle type. For 61-MeV incident protons on carbon, angular distributions are given for energy-integrated cross sections for emission of each of the five observed particles and for excitation of prominently excited states. Similar data are given for the oxygen target, except that few angular distributions are given for excitation of specific states. Angle-integrated energy spectra in both center-of-mass and laboratory systems are presented for each of the five outgoing particles. Since plastic scattering foils were used, cross sections for p-p scattering were obtained which proved to be consistent with interpolated values from the literature. Data analysis procedures are described and experimental uncertainties are tabulated. (auth)

22803 PHF CALCULATION FOR ^{12}C WITH THE REALISTIC INTERACTION OF GALONSKA, FAESSLER, AND APPEL. Bouten, M.; Bouten, M. C. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Z. Phys.; 261: No. 2, 169-176(1973).

Carrying out a projected Hartree–Fock calculation for ^{12}C with the realistic matrix elements of Galonska, Faessler and Appel and constraining the nuclear radius in order to get enough saturation, one is led to a problem similar to the one discussed by Bassichis and Wilets in a recent Physical Review Letter. A simple alternative solution is proposed and results are presented for the ground-state band and the 4p–4h state in ^{12}C. (3 figures, 1 table) (auth)

22804 INELASTIC ELECTRON SCATTERING AND THE BROWN–GREEN MODEL FOR ^{16}O. II. The Odd-Parity States. Erikson, T. (Nordita, Copenhagen). Nucl. Phys.; A211: No. 1, 105-124(1973).

A calculation of first Born approximation of the form factors for inelastic electron scattering, based on the description of the ground state and of the excited odd-parity states of ^{16}O given by Brown and Green, is presented. The predictions of the model, including a selection rule for electric and magnetic transitions, are found to be in reasonable agreement with experiments. (auth)

22805 APPLICATION OF OFF-SHELL R-MATRIX THEORY TO THE DESCRIPTION OF RESONANCES OBSERVED IN $^{15}N(d,p)^{16}N$(unbound). Moehring, K.; Lipperheide, R. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Nucl. Phys.; A211: No. 1, 136-144(1973).

The off-energy-shell behavior of resonances in the ^{16}N system as observed in the stripping reaction $^{15}N(d,p)^{16}N$(unbound) is interpreted within the framework of off-shell R-matrix theory. Changes in the size and shape of the resonances in the nucleus ^{16}N as a function of stripping angle are explained. (auth)

22806 ANGULAR DISTRIBUTION OF 1.04-GeV PROTONS SCATTERED BY ^{12}C, ^{58}Ni, ^{208}Pb. Bertini, R.; Beurtey, R.; Brochard, F.; Bruge, G.; Catz, H.; Chaumeaux, A.; Durand, J. M.; Faivre, J. C.; Fontaine, J. M.; Garreta, D.; Gustafsson, C.; Hendrie, D.; Hibou, F.; Legrand, D.; Saudinos, J.; Thiron, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 45B: No. 2, 119-122(9 Jul 1973).

Angular distribution measurements for elastic and inelastic scattering of 1.04-GeV proton by ^{12}C, ^{58}Ni and ^{208}Pb with an energy resolution of the order of 100 keV are presented. (auth)

22807 PHOTOPRODUCTION OF CHARGED PIONS FROM ^{16}O. Rej, A. K.; Engeland, T. (Univ. of Oslo, Blindern, Norway). Phys. Lett.; 45B: No. 2, 77-80(9 Jul 1973).

Photoproduction of π^+ from ^{16}O leading to the four bound states in ^{16}N was studied using different dynamical amplitudes and considering particle-hole correlations in the nuclear wave functions. It is shown that the total cross section is strongly affected by the choice of dynamical amplitudes whereas the effect of 3p–3h correlations in ^{16}N is small. (auth)

22808 P-NUCLEUS ELASTIC SCATTERING AT 1 GeV. Auger, J. P. (Laboratoire de Physique, Orleans, France); Lombard, R. J. Phys. Lett.; 45B: No. 2, 115-118(9 Jul 1973).

The p-nucleus elastic scattering differential cross section at 1 GeV was calculated for ^{12}C, ^{58}Ni and ^{208}Pb using the Glauber multiple scattering theory. A reasonable fit to experimental data is obtained without adjustable parameter. (auth)

22809 HOLE SPECTRUM OF ^{12}C. Fritsch, W. (Hahn-Meitner Institut fuer Kernforschung, Berlin); Lipperheide, R.; Wille, U. Phys. Lett.; 45B: No. 2, 103-106(9 Jul 1973).

The proton hole spectrum of ^{12}C was investigated in the framework of the continuum shell model with residual interactions. Calculated separation-energy spectra for the reaction $^{12}C(p, 2p)$ show strong deviations from previous results which were obtained by the Green function method with a second-order mass operator. (auth)

22810 ELASTIC AND INELASTIC SCATTERING OF ^{3}He FROM ^{12}C AT 24.0, 29.2, 34.7, AND 39.6 MeV. Fujisawa, T.; Yamaji, S.; Matsuda, K.; Motonaga, S.; Yoshida, F. (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys. Soc. Jap.; 34: No. 1, 5-13(Jan 1973).

The measurements were made at center-of-mass angles extending from 14° to 128° or 172°. The yield of inelastic scattering at most angles was of the same order as the elastic scattering. A Thomas type spin-orbit coupling of the optical potential is useful for the elastic scattering at backward angles. Discrete and continuous ambiguities in the optical model parameters appeared in the analysis. The experimental values of inelastic scattering were predicted fairly well by the DWBA theory, and the deformation parameters β_2 were about 0.5. In the coupled channel analysis, the predicted values of elastic scattering were much different from the results of optical model analyses by coupling to the inelastic channel, and the potential whose imaginary part was shallower than that given by the optical model analysis gave better fit. The value of β must be -0.5 for 39.6 and 34.7 MeV. (auth)

22811 THEORETICAL ASYMMETRY RATIOS IN LOW-ENERGY PHOTON LINEAR-POLARIZATION MEASUREMENTS BY PAIR PRODUCTION. Proriol, J.; Parizet, M. J.; Vialle, M. (Univ., Clermont, France). Lett. Nuovo Cim.; 7: No. 15, 724-726(11 Aug 1973).

The use of a streamer chamber to study low energy photon linear polarization measurements by pair production is tested in the reaction $^{15}N(p,\alpha\gamma)$ at 4.43 MeV. The asymmetry ratio is computed for a linearly polarized photon. (JFP)

22812 SINGLE-NUCLEON "HOLE" STATES PRODUCED IN KNOCK-OUT REACTIONS. Berggren, T.; Ohlen, G. (Lund Inst. of Tech., Sweden). Lett. Nuovo Cim.; 7: No. 15, 701-706 (11 Aug 1973).

For the theory of reactions leading to the knock-out of an inner-shell nucleon producing a residual nucleus which is in a highly excited and therefore particle-unstable state, it is pointed out that one can in a consistent way introduce a complex component in the effective potential which is physically a direct consequence of the unbound character of the core. The state of the least bound nucleon in lithium-6 is considered. The (p,2p) cross sections are computed. (JFP)

22813 EFFECTIVE CROSS SECTION OF $^{19}F(\gamma,xn)$ REACTION. Catana, D.; Baciu, G.; Iliescu, C.; Niculescu, V. I. R. (Institutul de Fizica Atomica, Bucharest). Z. Phys.; 261: No. 2, 125-136 (1973).

The $^{19}F(\gamma,xn)$ reaction cross section has been measured with a 100 keV bin in the range from threshold up to 25 MeV. The analysis of the yield curve is based on the least structure solution using the thick target forward direction bremsstrahlung spectrum. For a most comprehensive analysis of data, based on the Penfold–Leiss method, the experimental cross section for the above reaction has been calculated twice, applying different types of bremsstrahlung spectrum. Finally, taking into account the Nilsson level scheme and treating ^{19}F as a deformed nucleus, the total E1 photoabsorption cross section was computed and compared with our and other published experimental data. (6 figures, 2 tables) (auth)

22814 STRUCTURES IN THE EXCITATION FUNCTIONS FOR COMPOUND REACTIONS IN THE $^{12}C + ^{14}C$ SYSTEM. Feil, M. (Max-Planck-Institut fuer Kernphysik, Heidelberg); von Oertzen, W.; Bohlen, H. G.; Gamp, A.; Walter, R. L.; Kohlmeyer, B. Z. Phys.; 260: No. 4, 271-282(1973).

Excitation functions for the elastic scattering of ^{12}C on ^{14}C and the reactions $^{14}C(^{12}C,\alpha)^{22}Ne$, $^{14}C(^{12}C,t)^{23}Na$ and $^{14}C(^{12}C,d)^{24}Na$ have been measured in the vicinity of the Coulomb barrier. Strong fluctuations of the differential cross sections as a function of incident energy are observed in the α-particle, triton and deuteron channels. The total yield in the three different channels shows correlated structures at energies E_{cm} = 6.8, 7.2 and 8.3 MeV. This phenomenon is similar to the structures observed in the $^{12}C + ^{12}C$ reactions and indicates the possible presence of resonances in the entrance channel. (7 figures, 1 table) (auth)

22815 BRANCHING RATIOS OF ^{7}Be AND ^{65}Zn. Poenitz, W. P.; Devolpi, A. (Argonne National Lab., IL). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 471-475(Aug 1973).

The branching ratios of the electron-capture transitions in the decay of ^{7}Be and ^{65}Zn were measured to be 0.1042 ± 0.0018 and 0.493 ± 0.008 at the 68% confidence level, respectively. They were obtained by measuring the neutron yields from the reactions

^{7}Li(p,n)^{7}Be and ^{65}Cu(p,n)^{65}Zn and the γ-ray activities of the residual nuclei. Neutron emission was determined with a calibrated vanadium bath surrounding the target; and the γ-ray activity, measured with a sodium iodide detector calibrated against standard radioactivity sources. Results are compared with previously published data. (auth)

22816 INTERACTING BOSON MODEL STRUCTURE OF ^{16}O. Fesbach, H. (Massachusetts Inst. of Tech., Cambridge). Iachello, F. Phys. Lett.; 45B: No. 1, 7-11(25 Jun 1973).

The recently proposed interacting boson approximation (IBA) is applied to the structure of ^{16}O. The T = 0, J = 0^+, 2^+, 4^+, 1^-, 3^- states below 18 MeV are calculated and compared with the known experimental levels. The agreement obtained indicates the usefulness of the IBA. The limitations of the model are briefly discussed. (auth)

22817 INVESTIGATIONS ON THE SCATTERING OF α-PARTICLES ON ^{7}Li. Kelleter, H.; Hrehuss, G.; Mayer-Boericke, C. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A210: No. 3, 502-508(1973).

Excitation functions of α-scattering on ^{7}Li leading to the ground and first excited states have been measured in the bombarding energy regions 8.6 to 12.5 MeV and 17.0 to 22.5 MeV at c.m. scattering angles of 54.2, 72.4 and 89.8°. A systematic deviation from smooth behavior is revealed which, because of its regularity, is attributed to the exchange of a triton cluster between two α-particles. (auth)

22818 POLARIZATION AND PHASE SHIFTS IN ^{9}Be(p,p)^{9}Be FROM 0.8 TO 2.7 MeV AND THE STRUCTURE OF ^{10}B. Rohrer, U. (Univ., Basel); Brown, L. Nucl. Phys.; A210: No. 3, 465-476 (1973).

Angular distributions of the analyzing power in ^{9}Be(p⃗,p)^{9}Be have been measured to an accuracy of about ±0.03 at 21 energies from 0.9 to 2.7 MeV with a target thickness of 20 keV at 1 MeV. These data and the cross section measurements of others are reproduced well in the region from 0.8 to 1.6 MeV by a set of phase shifts that vary reasonably with energy. The $^{3}S_1$, $^{5}S_2$, $^{5}P_1$, and $^{5}P_2$ phases suffice to describe the data, although channel spin and s-d mixing are required. Three levels satisfy the data: at 0.980 ± 0.010 MeV are two levels, a 1^+ of width 0.10 MeV and a 2^- of width 0.11 MeV; at 1.37 ± 0.02 MeV is a 1^- level of width 0.30 MeV. The 1^+ and 1^- states do not agree with earlier assignments. Outside of the energy region from 0.8 to 1.6 MeV a satisfactory set of phases could not be obtained, owing to inadequate data. These regions were studied in the analysis, however, and the results are discussed. (auth)

22819 FACTORIZATION AND HADRON–CARBON SCATTERING. Snell, V. (Cambridge Univ., Eng.). Nuovo Cim.; 16A: No. 4, 547-556(21 Aug 1973).

A recent experiment on the scattering of hadrons on carbon is analyzed in a simple Regge-pole model. Use of carbon as a target allows a test of the factorization of the residue of each contributing Regge pole. Using as input the Regge residues given by a parametrization of the high-energy hadron-hadron cross-sections, together with the experimental values of the cross-sections $\sigma(K^-C) \pm \sigma(K^+C)$ and $\sigma(\bar{p}C) + \sigma(pC)$ at one energy, the coupling constants of the Regge poles to the carbon nucleus and thus a prediction of $\sigma(\bar{p}C) - \sigma(pC)$ and $\sigma(\pi C)$ are obtained. A comparison with the data on these cross-sections reveals agreement to within the experimental and theoretical errors, but an examination of the real part of the amplitude reveals non-Regge-pole behavior; thus the question of factorization of the P′ and ω residues is not resolved. (auth)

22820 APPROACH TO PION–NUCLEUS SCATTERING NEAR THE (3,3) RESONANCE WITH A DYNAMICALLY MODIFIED OPTICAL POTENTIAL. Barshay, S. (Univ. of Copenhagen); Rostokin, V.; Vagradov, G. Nucl. Phys.; B59: No. 1, 189-210 (1973).

A new approach to pion-nucleus scattering near the first pion-nucleon resonance is developed which is based upon the modification of the pion Green function due to isobar-hole excitation in the nuclear medium. Pion-nucleon scattering in the medium is modified in at least two essential ways: (i) the wave number is changed from the free-space value and (ii) the isobar mass (and width) are modified in the medium. These modifications are important because the elementary scattering amplitude is a resonant, and hence strongly varying, function of these variables. A dynamically modified effective optical potential is constructed. The essential results are: (i) the growth of the attractive real potential with nuclear density is limited, and thus so is the growth of the pion wave number in the medium; (ii) the resonance structure is broadened and is shifted downward in energy, in the medium, since the increase in the real part of the wave number in the attractive medium compensates in the P-wave scattering amplitude for the lower beam energy. An essential new quantity appears in the formulation of the effective optical potential denoted by $(V^* - V) = \Delta m^*$. This quantity includes a shift in the effective mass of the composite isobar in the medium due to the interactions of the component pion, and due to the Pauli principle restriction upon the component nucleon. The quantity also includes a possible difference between the binding potential felt by an isobar and by a nucleon in the medium. (auth)

22821 (π^+,2p) REACTIONS ON THE LITHIUM NUCLEI AT E = 85 ± 4 MeV. Nadezhdin, V. S.; Petrov, N. I.; Satarov, V. I.; Vzorov, I. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1134-1142(Jun 1973). (In Russian).

The differential cross sections, summed proton energy spectra, and recoil momentum distribution were measured for the (π^+,2p) reaction on ^{6}Li and ^{7}Li at the energy E = 85 ± 4 MeV. The measurements for ^{6}Li were carried out with six sets of pairs of angles characterizing the position of the proton detectors relative to the π^+-meson beam. The ^{7}Li measurements were made for three sets. The data obtained are compared with theoretical predictions. The cross sections for π^+ capture by nuclear quasi-deuterons are shown to exceed the corresponding quantities for free deuterons. (2 figures, 4 tables) (auth)

22822 DESCRIPTION OF NUCLEAR ANOMALOUS-PARITY STATES IN THE K-HARMONICS METHOD. Zhukov, M. V.; Zhurina, M. I.; Shitikova, K. V. (Moscow State Univ.). Yadern. Fiz.; 17: No. 6, 1191-1196(Jun 1973). (In Russian).

An approach is given using the connection of the matrix elements from the K-harmonics method with the corresponding shell-model matrix elements. This approach is applied to the description of properties of nuclear anomalous-parity levels, whose K-harmonics expansion begins with a term $K = K_{min} + 1$. The binding energies and mean square radii are calculated as well as the wave functions of the ground and excited (in the collective variable ρ) states of the ^{16}O nucleus with J = 1^-, T = 1 (taking and not taking into account the 1d–2s mixture). The probabilities of dipole transitions to the excited states with J = 1^-, T = 1 are also estimated. (4 figures, 1 table) (auth)

22823 ELECTROMAGNETIC DE-EXCITATION OF THE 1^- LEVELS AT 12.44 AND 13.09 MeV IN ^{16}O. Brochard, F.; Chevallier, P.; Disdier, D.; Rauch, V.; Scheibling, F. (CNRS, Strasbourg). J. Phys. (Paris); 34: No. 5, 363-367(May 1973). (In French).

The de-excitation of the 1^- levels situated at 12.44 and 13.09 MeV in ^{16}O was studied, and two new transitions were observed. A new determination of the parameters of the two 1^- levels was made. (auth)

22824 POSITIVE PION PRODUCTION OF ^{12}C BY 185 MeV PROTONS. Dahlgren, S.; Grafstroem, P.; Hoeistad, B.; Asberg, A. (Univ. of Uppsala). Nucl. Phys.; A211: No. 2, 243-253(1973).

Energy spectra of positive pions produced in the reaction $^{12}C(p,\pi^+)^{13}C$ at T_p = 185 MeV have been recorded in the angular range 15°–130° (lab). Six peaks corresponding to levels in ^{13}C have been resolved. Angular distributions for these peaks are presented in tables and graphs. The results are compared with a calculation in a one-nucleon model. (auth)

22825 $^{13}C(d,\gamma_0)^{15}N$ AND THE $^{11}B(d,\gamma_0)^{13}C$ CROSS SECTIONS IN THE REGION OF THE GIANT DIPOLE RESONANCE. Weller, H. R.; Blue, R. A. (Univ. of Florida, Gainesville). Nucl. Phys., A211: No. 2, 221-231(1973).

The (d,γ_0) cross section has been measured at 90° for deuteron energies in the range of ≈1 to 4 MeV for targets of ^{13}C and ^{11}B. In each case the measurements reveal a single resonance structure near $E_d \approx 2$ MeV. On-resonance angular distributions have been obtained. The observed structure, which occurs at energies in the region of the giant dipole resonance of ^{15}N and ^{13}C, respectively, is compared to single-nucleon-capture data in the giant dipole region of these nuclei. (auth)

22826 MEAN LIFETIMES IN ^{14}N. Haas, F.; Freeman, R. M.; Heusch, B.; Kohmoto, S.; Gallmann, A. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys., A211: No. 2, 289-298 (1973). (In French).

The Doppler shift attenuation method has been used to measure the lifetimes of ^{14}N excited states produced in the $^{12}C(^{3}He,p)^{14}N$ reaction. Gamma rays were detected at θ_γ = 0° and 90° in coincidence with proton groups observed at 180° in an annular detector. The lifetimes obtained are as follows: 2.31 MeV level, τ = 114 ± 30 fs; 3.95 MeV level, τ < 28 fs; 4.91 MeV, τ < 28 fs; 5.69 MeV level, τ < 21 fs; 6.20 MeV level, τ = 200 ± 45 fs; 6.44 MeV level, τ = 630 ± 100 fs. These results are compared with

previous measurements and recent theoretical predictions using the weak coupling approach. (auth)

22827 ANGULAR DISTRIBUTION OF POLARIZATION OF THE NEUTRONS FROM THE $^{14}C(d,n_0)^{15}N$ REACTION FOR DEUTERON ENERGIES BETWEEN 1.3 AND 1.9 MeV. Niecke, M.; Zach, A. (Univ., Hamburg). Z. Phys.; 261: No. 4, 337-342(1973). (In German).

Polarization distributions of ground state neutrons emitted from the $^{14}C(d,n_0)^{15}N$ reaction were investigated over the angular range from 15° (lab) to 150° (lab) at bombarding energies of 1.28, 1.55 and 1.88 MeV. Scattering of neutrons from helium served as polarization analyzer. The experimental results show a large variation with energy of the polarization ranging between $P(\Theta_{lab} = 130°) = -21\%$ and $P(\Theta_{lab} = 130°) = +50\%$ at 1.28 and 1.88 MeV, respectively. (3 figures, 1 table) (auth)

22828 INTERPRETATION OF DE-EXCITATION GAMMA RAY MEASUREMENTS FOLLOWING THE PHOTODISINTEGRATION OF ^{12}C, ^{16}O, AND ^{40}Ca. Spicer, B. M. (Catholic Univ. of America, Washington, DC). Aust. J. Phys.; 26: No. 3, 269-277(Jun 1973).

The relative populations of final states in photonuclear reactions for ^{12}C, ^{16}O, and ^{40}Ca are examined in the light of information on the known major configurations present in the wave functions of those final states, with the assumption that the nucleon excited in the radiation absorption process is in fact the one emitted. This assumption is investigated and found to be reasonable for ^{12}C and ^{16}O but not for ^{40}Ca. The data on relative populations of final states are interpreted to give information on the relative strengths of configurations in the wave functions of the ground states of the three nuclei. (auth)

22829 DIRECT REACTION INELASTIC SCATTERING TO THE 2^- STATE OF ^{16}O VIA A NONLOCAL INTERACTION. Ruzzene, F.; Smos, K. (Univ. of Melbourne, Parkville, Australia). Aust. J. Phys.; 26: No. 3, 315-325(Jun 1973).

A study is made of the effects of a purely nonlocal representation of the reaction mechanism in inelastic scattering. In particular, the inelastic scattering of 30 MeV protons and 65 MeV α-particles leading to the 2^- state of 8.88 MeV excitation in ^{16}O is considered. The reaction mechanisms are represented by separable interactions between the projectile and target nucleon, and a simple spectroscopy for ^{16}O is used in the plane wave Born approximation. The derived cross sections are compared with other calculations and the measured data. The asymmetry in proton inelastic scattering is also discussed. (auth)

22830 ANALYSIS OF SOME NEUTRON TRANSFER REACTIONS USING MICROSCOPIC FORM FACTORS. Igarashi, M. (Tokyo Medical Coll.); Kawai, M.; Yazaki, K. Progr. Theor. Phys. (Kyoto); 49: No. 3, 825-851(Mar 1973).

Form factors of one-neutron transfer reactions were calculated for the transitions between the two-neutron (or neutron-hole) states of ^{18}O, ^{58}Ni, ^{210}Pb, ^{14}N and ^{206}Pb and the single-neutron (or neutron-hole) states of the neighboring nuclei using the known shell-model wave functions and corresponding two-body interactions. For strong transitions the calculated form factor F is close to that given by the separation energy method F_{SE}, while for weak transitions they are considerably different. The shape of F is intermediate between F_{SE} and F_{EFB} given by the effective binding energy method. Strong correlation was found between the relative importance of the two-body interaction in F and the energy shift of the two-particle (or -hole) level from the zeroth-order shell-model energy. The angular distribution calculated either by DWBA or by the adiabatic theory of Johnson and Soper (AD) was quite insensitive to the shape of the form factor inside the nucleus, although the magnitude was sometimes different by a factor of 4 depending on whether F or F_{SE} was used. For $^{18}O(p,d)^{17}O$ and the weak transitions in $^{210}Pb(p,d)^{209}Pb$, no satisfactory agreement was obtained by either AD or DWBA. It is suggested that two-step mechanisms may be important in these processes. (auth)

22831 INVESTIGATION OF TWO RESONANCES IN THE $^{18}O(p,n)^{18}F$ REACTION. Fritsch, W.; Buechs, K. D.; Finckh, E.; Pietrzyk, P.; Schreiber, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Phys.; 262: No. 1, 65-70(1973).

Excitation functions for the $^{18}O(p,n)^{18}F$ reaction were measured at bombarding energies $E_{(p)} = 4.6$ to 6.6 MeV. In and near two resonances of the yield curves at $E_{(p)} = 5.622$ and 6.061 MeV, angular distributions were measured with neutron time-of-flight techniques. The strong neutron decay to the $T = 1$ state in ^{18}F and the similarity of the $^{18}O(p,n)$ and $^{18}O(n,n)$ yield curves give good evidence that the structures in the $^{18}O(p,n)$ yield curve arise from the formation of $T = 1/2$ states in ^{19}F. A two-level-analysis does not give satisfactory fits to the strongly asymmetric angular distributions. (3 figures) (auth)

22832 ELASTIC SCATTERING OF HIGH ENERGY PROTONS FROM ^{12}C. Matsuzaki, H. (Tohoku Coll. of Pharmacy, Sendai). Progr. Theor. Phys. (Kyoto); 49: No. 3, 1056-1058(Mar 1973).

The proton elastic scattering cross section of ^{12}C was calculated using harmonic oscillator wave functions and Glauber theory. The oscillator strengths which give good agreement with experiment give poor agreement with electron scattering results. (JWR)

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Refer also to abstracts 21330, 22226, 22524, 22624, 22762, 22768, 22775, 22780, 22787, 22796, 22801, 22876, 22886, 22919, 22954, 22955, 23016, 23070, and 23132.

22833 (BNL-50379) NEUTRON AND GAMMA RAY PRODUCTION CROSS SECTIONS FOR SILICON. Bhat, M. R.; Goldberg, M. D.; Kinsey, R. R.; Prince, A.; Takahashi, H. (Brookhaven National Lab., Upton, N. Y.). Mar. 1973. Contract AT(30-1)-16. 60p. (ENDF-186). Dep. NTIS $3.00.

A reevaluation of Si neutron and photon production cross sections by the National Neutron Cross Section Center is described. Finished in Sept. 1972, it used all data available at that time. The following topics are covered: general properties of Si isotopes (mass, possible neutron reactions, energy levels, gamma rays produced by neutron reactions), neutron cross sections (total cross section, (n,α) cross section, elastic and inelastic scattering cross sections), angular distribution of secondary neutrons from elastic and inelastic scattering, and gamma-ray production cross sections (production of radiative-capture gammas, production of gammas from inelastic scattering, energy distribution of secondary gammas). (39 figures, 10 tables) (RWR)

22834 (CEA-N-1466(2)) CROSS SECTIONS OF NUCLEAR REACTIONS INDUCED BY PROTONS, DEUTERONS, AND ALPHA PARTICLES. 2. Fluorine, Neon, Sodium, Magnesium. de Lassus St-Genies, C. H.; Tobailem, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec 1972. 183p. (In French). Dep. NTIS (U. S. Sales Only) $11.25.

Cross sections are reviewed for nuclear reactions induced by protons, deuterons and alpha particles on fluorine, neon, sodium and magnesium targets. When necessary, published experimental data are corrected, and, when possible, excitation functions are proposed. (FR)

22835 (CEA-N-1600, pp 19-21) TWO-PROTON TRANSFER IN THE $(^{12}C,^{10}Be)$ REACTION ON ^{18}O AND ^{26}Mg TARGETS. Conjeaud, M.; Da Silveira, E.; Gaillard, P.; Harar, S.; Volant, C. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The transfer of two protons in the $(^{12}C,^{10}Be)$ reaction on ^{18}O and ^{26}Mg was studied. These reactions are highly selective. The angular distributions were measured; they present a strong oscillatory pattern for the $L = 0$ transfer. (auth)

22836 (CEA-N-1600, pp 85-87) ASYMMETRY CALCULATIONS FOR THE INELASTIC SCATTERING OF POLARIZED PROTONS ON ^{32}S. Escudie, J. L.; Gosset, J.; Kamitsubo, H.; Lombard, R. M.; Mayer, B.; Raynal, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Coupled-channels analysis of asymmetry measurements for low-lying states of ^{32}S is discussed. Differential cross sections and analyzing power for elastic and inelastic scattering of 24.5-MeV protons from ^{32}S were measured. Special effort was made to extract cross sections and analyzing power for the excitation of states which occur in the two-phonon region. The coupled-channels theory is used to interpret the excitation of the two-phonon state. An appreciably better fit to the observed cross section for the excitation of the second 2^+ state is obtained if a small admixture of the one-phonon state is assumed for the description of this state. A strong component of direct 4^+ phonon is admixed to the 4^+ two-phonon state. (1 figure, 1 table) (auth)

22837 (CEA-N-1600, pp 100-102) STUDY OF $^{28}Si(^3He,d)^{29}P$ AND $^{28}Si(^3He,p)^{30}P$ REACTIONS. Bruge, G.; Chaumeaux, A.; Guichard, A.; Fortier, S.; Leleux, P. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The $^{28}Si(^3He,d)^{29}P$ and $^{28}Si(^3He,p)^{30}P$ reactions were studied at 35.3 MeV. The angular distributions measured from 9 deg to 57 deg c.m. are analyzed by using DWBA calculations. (auth)

22838 (CONF-730312-(P2), pp 429-439) ^{16}O INDUCED TRANSFER REACTIONS ON ^{26}Mg, ^{27}Al, AND ^{30}Si. Ball, J. (Univ. of

Copenhagen); Christensen, P. R.; Hansen, O.; Larsen, J. S.; Sinclair, D.; Videbaek, F.; Broglia, R. A.; Liotta, R.; Nilsson, B. Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Targets of ^{26}Mg, ^{27}Al, and ^{30}Si were bombarded with ^{16}O at laboratory energies of 45, 60, and 70 MeV. The beams were produced by a super-FN tandem accelerator, and the reaction products were detected in ΔE-E solid-state counter telescopes. Detailed analyses have been done only for the ^{26}Mg–^{16}O reactions, for which angular distributions are shown. (LTW)

22839 (CONF-730312-(P2), pp 541-548) ELASTIC NEUTRON TRANSFER IN THE SCATTERING OF Si ISOTOPES. Hildenbrand, K. D.; Bock, R.; Bohlen, H. G.; Braun Munzinger, P.; Fick, D.; Gelbke, C. K.; Weiss, U.; Weiss, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Elastic neutron transfer in the scattering of ^{28}Si on ^{28}Si, ^{29}Si, and ^{30}Si was studied, and angular distributions are shown. (LTW)

22840 (CONF-730312-(P2), pp 589-594) REACTIONS ^{26}Mg(^{16}O, ^{15}N)^{27}Al AND ^{30}Si(^{16}O, ^{15}N)^{31}P AT 42 MeV. Lewis, T. J.; Wedberg, G. H.; Maher, J. V.; Peng, J. C.; Ricci, J. L.; Cheng, C. M. (Univ. of Pittsburgh). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

^{16}O ions of 42 MeV from a three-stage Van de Graaff accelerator were used to bombard targets of enriched ^{26}Mg metal and SiO enriched in ^{30}Si. An array of three Au–Si surface barrier detector telescopes was used to identify and measure the energy of the emerging ions. Angular distributions for transitions populating final states in ^{27}Al and ^{31}P are shown. Absolute cross sections for (^{16}O, ^{15}N) transitions were determined from comparison with elastic scattering data acquired simultaneously with the (^{16}O, ^{15}N) measurements. The results of no-recoil DWBA calculations are shown. Spectroscopic factors were extracted. (LTW)

22841 (CONF-730312-(P2), pp 597-604) BEAM ENERGY DEPENDENCE OF ^{24}Mg(^{16}O, ^{12}C)^{28}Si REACTION. Maher, J. V.; Wedberg, G. H.; Erb, K. A.; Peng, J. C.; Ricci, J. L. (Univ. of Pittsburgh). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

^{16}O ions from a three-stage Van de Graaff were used to bombard a target of enriched ^{24}Mg. Two Au–Si surface barrier detector telescopes (placed 10° apart) were used to identify and measure the energy of the emerging ions. Absolute cross sections at various beam energies were determined. Angular distributions were measured at 36, 38, 40, 42, 44, 46, and 48 MeV. (LTW)

22842 (FRNC-TH-385) STUDY OF EXCITED STATES OF THE ^{35}Cl NUCLEUS FED BY THE ^{34}S(p,γ) RADIATIVE CAPTURE REACTION. Hubert, P. (Bordeaux Univ. (France)). 1972. 84p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis.

The excited states of ^{35}Cl were studied from the radiative capture of ^{34}S(p,γ). Numerous resonances were observed in the E_p = 700 keV to 2100 keV energy region. Measurements of energies, strengths, and branching ratios led to the limiting of the possible spins and parities of the resonant levels. A strong resonance, already identified as an isobaric analogue resonance, was revealed to be a doublet, the possibility of an even finer structure not being ruled out. The gamma de-excitation schemes for the resonances enabled the bound level scheme for ^{35}Cl to be established up to an excitation energy of about 6 MeV and the existence of several new levels to be established. The matrix elements of the electromagnetic transitions associated with the first excited levels were obtained, and the spin and parity of certain bound levels were discussed. The Nilsson model with Coriolis coupling corrections accurately reproduces the properties of the first levels. The unified model in the intermediate coupling approximation gives very qualitative results. Calculations based on the shell model made for ^{16}O are the most satisfactory. (FR)

22843 (LBL-1666, pp 74-76) NEW SPECTROSCOPIC MEASUREMENTS VIA EXOTIC NUCLEAR REARRANGEMENT: THE ^{26}Mg(^{7}Li,^{8}B)^{25}Ne REACTION. Wilcox, K. H.; Jelley, N. A.; Wozniak, G. J.; Weisenmiller, R. B.; Harney, H. L.; Cerny, J. May 1973.

In nuclear chemistry annual report, 1972.

22844 (LBL-1666, pp 85-86) HEAVY-ION DIRECT REACTIONS AT HIGH ENERGIES. Puehlhofer, F.; Becchetti, F.; Harvey, B. G.; Kovar, D. G.; Mahoney, J.; Mayer, B.; Sherman, J. D.; Zisman, M. S. May 1973.

In nuclear chemistry annual report, 1972.

22845 (LBL-1666, pp 97-100) SYSTEMATICS OF THE (α,2α) REACTION. Sherman, J. D.; Hendrie, D. L. May 1973.

In nuclear chemistry annual report, 1972.

22846 (LBL-1666, pp 109-112) ON-LINE MASS SPECTROMETRIC MEASUREMENT OF THE MASSES OF NEUTRON RICH SODIUM ISOTOPES. Klapisch, R.; Prieels, R.; Thibault, C.; Poskanzer, A. M.; Rigaud, C.; Roeckl, E. May 1973.

In nuclear chemistry annual report, 1972.

22847 ENERGY SPECTRUM OF THE γ QUANTA PRODUCED FROM THE INTERNAL TARGET OF THE 70-GeV PROTON SYNCHROTRON. Dunaitsev, A. F.; Ivan'shin, Yu. I.; Kakauridze, D. B.; Karpov, I. I.; Mestvirishvili, A. N.; Morozov, B. A.; Saraikin, A. I.; Tyapkin, A. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 6, 1230-1234(Jun 1973). (In Russian).

The results of measuring the energy spectrum of the γ quanta produced from the internal target of the 70-GeV proton synchrotron at the angle of 1° relative to the primary proton beam are presented. The experimental technique and the data processing are considered. (auth)

22848 STUDY OF THE STATES OF ^{30}Si WITH THE ^{28}Si(t,p) AND ^{29}Si(d,p)^{30}Si REACTIONS. Baxter, A. M.; Hinds, S. (Australian National Univ., Canberra). Nucl. Phys. A211: No. 1, 7-20(1973).

The excitation energies of the levels in ^{30}Si were measured up to an excitation of 9.46 MeV with the ^{28}Si(t,p)^{30}Si reaction at a triton energy of 6.0 MeV. Angular distributions were measured of proton groups from the ^{28}Si(t,p)^{30}Si and ^{29}Si(d,p)^{30}Si reactions in a multi-angle magnetic spectrograph. Triton bombarding energies of 10.5 and 12.1 MeV were used and the deuteron incident energy was 10.0 MeV. States in ^{30}Si up to an excitation of 8 MeV were observed. Spins and parities of several states were assigned using an empirical method for the (t,p) results and using a DWBA analysis for the (d,p) distributions. Spectroscopic factors for twelve states were obtained from the latter analysis. Two of these disagree with theoretical predictions. The state previously reported at an excitation of 6.63 MeV in ^{30}Si was observed to be formed by a strong L = 0 transition in the (t,p) reaction and also by a strong l = 1 transition in the (d,p) reaction. It is deduced that there are two closely spaced states at about this excitation, one having a spin and parity of 0^+ and the other 0^-, 1^- or 2^-. (auth)

22849 RELATION BETWEEN THE BACKGROUND CROSS SECTION AND THE CORRELATION BETWEEN PARTIAL WIDTHS. Boridy, E. (Univ., Liege); Mahaux, C. Phys. Lett.; 45B: No. 2, 81-84(9 Jul 1973).

A relation is derived between the background cross section and the correlation coefficient between partial width amplitudes, in the frame of the shell-model approach to nuclear reactions. It involves explicitly the resonance parameters, and in contrast to an otherwise equivalent relation recently derived by Lane, a direct contribution. The result is applied to the reactions ^{29}Si(γ,n), ^{169}Tm(n,γ) and ^{208}Pb(γ,n). It is shown that the relation between the observation of an asymmetric resonance peak and the existence of a sizable background cross section is not straightforward. (auth)

22850 ABRUPT CHANGE BETWEEN SMOOTH AND OSCILLATORY ANGULAR DISTRIBUTIONS IN ^{16}O INDUCED TRANSFER REACTIONS ON ^{26}Mg. Christensen, P. R.; Hansen, O.; Larsen, J. S.; Sinclair, D.; Videbaek, F. (Univ. of Copenhagen). Phys. Lett.; 45B: No. 2, 107-109(9 Jul 1973).

Angular distributions from (^{16}O, ^{15}N) and (^{16}O, ^{14}C) reactions on ^{26}Mg were measured at both 45 and 60 MeV bombarding energies. The two reactions have approximately the same peak cross sections, but the (^{16}O, ^{15}N) distributions vary smoothly with angle while the (^{16}O, ^{14}C) cross section oscillates strongly as a function of angle. It is shown that the angular distribution shape is strongly dependent on the steepness of the form factor and that the magnitude of the (^{16}O, ^{14}C) cross section is very sensitive to the absorptive part of the optical potential. (auth)

22851 SEARCH FOR HIGH-SPIN STATES IN ^{29}Si USING A NEUTRON TIME-OF-FLIGHT SPECTROMETER. Betz, P.; Roepke, H. (Univ., Freiburg i. B.). Z. Phys.; 261; No. 4, 351-357(1973).

The ^{26}Mg(α,nγ) reaction has been used in connection with a neutron time-of-flight spectrometer to search for high spin states in ^{29}Si between E_x = 8.4 and 11.4 MeV. The γ-decay of twenty levels

has been observed. Nine levels have not been observed before. A candidate for the $J^\pi = 13/2^-$, $K = 7/2$ state has been located with the $E_x = 8{,}761$ keV level. (4 figures, 1 table) (auth)

22852 INVESTIGATION OF GAMMA RAY TRANSITIONS AND LIFETIMES IN ^{35}Cl. Fant, B.; Keinonen, J.; Anttila, A.; Bister, M. (Univ. of Helsinki). Z. Phys.; 260: No. 3, 185-196(1973).

Forty-eight resonances of the $^{34}S(p,\gamma)^{35}Cl$ reaction in the proton range $E_p = 1-2$ MeV have been observed. Gamma decay of twenty-eight of these was investigated by means of a 55-cm^3 Ge(Li) detector, and the energies and branching ratios of several bound states have been determined. The Q-value was found to be 6367.0 ± 1.5 keV. The lifetimes 150 ± 20, 400 ± 140, 19 ± 4, 14 ± 2, 145 ± 50, 20 ± 5, 20 ± 4, 42 ± 4 and 7 ± 3 fs were determined with the DSA method for the states at 1,219, 1,763, 2,694, 3,003, 3,944, 3,967, 4,059, 4,178 and 4,882 keV, respectively. The experimental transition strengths were found to be in agreement with those given by many-particle shell-model calculations. (5 figures, 4 tables) (auth)

22853 EXPERIMENTAL INVESTIGATION OF THE MECHANISM OF THE (π^-,π^-p) REACTION ON ^{27}Al AT SMALL MOMENTUM TRANSFERS TO THE NUCLEUS. Bayukov, Yu. D.; Vorob'ev, L. S.; Kolybasov, V. M.; Leksin, G. A.; Smolin, V. L.; Fedorov, V. B. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 255-257(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 356-358(5 Apr 1973).

The reaction was studied with pions of momentum 1 GeV/c. By performing the experiment in a noncoplanar geometry it was possible to obtain the momentum distribution of the residual nucleus, and also the distribution with respect to the Treiman-Yang angle and with respect to the polar emission angle of the nucleus for different ranges of momentum transfer, q. The Butler form factor was used in the analysis, and variation of the radii and of the intensities of both channels was assumed. There is good agreement between the prediction of the pole mechanism with experiment in the region $q < 120$ MeV/c. It is thus seen that the pole diagram makes the decisive contribution at small q; with increasing q, contributions of other diagrams become important. Since the transition is to an excited state of ^{26}Mg, it can be assumed that the mechanism of the (π^-p) reaction does not depend on the state of the residual nucleus. Comparison of these results with those on other nuclei shows that the character of the deviation from the pole approximation is also independent, in the main, of the choice of the target nucleus. (3 figures) (RWR)

22854 FLUCTUATION STUDY OF THE $^{34}S(d,p)^{35}S$ REACTION. Comsan, M. N. H.; Farouk, M. A.; El-Behay, A. Z. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 21: No. 3, 203-206(1973).

Excitation functions of the $^{34}S(d,p)^{35}S$ reaction were measured for transitions to the lowest two excited states of ^{35}S in the energy interval 1.8 to 2.5 MeV. The excitation functions were analyzed on the basis of Ericson's fluctuation theory. An average level width for the ^{35}Cl compound nucleus was found to be (15.2 ± 3.1) keV at approximately equal to 15 MeV excitations. Cross angle correlation analysis led to a coherence angle $\Delta\Theta = (21.4 \pm 6.1)°$ which corresponds to a radius of interaction of (6.3 ± 2.4) fm. The nature of both intermediate structure and Ericson fluctuations is discussed in detail. (GE)

22855 STUDY OF RESONANCES IN THE $^{27}Al(p,\gamma)^{28}Si$ REACTION BETWEEN 2100 AND 3100 keV. Dalmas, J.; Bertault, D. (Univ., Bordeaux). J. Phys. (Paris); 34: No. 5, 357-361(May 1973). (In French).

The excitation functions of the $^{27}Al(p,\gamma)^{28}Si$, $^{27}Al(p,p'\gamma)^{27}Al$, and $^{27}Al(p,\alpha_\gamma)^{24}Mg$ reactions were investigated in the energy range 2100 to 3100 keV. Gamma ray spectra for twenty three resonances in the $^{27}Al(p,\gamma)^{28}Si$ reaction were studied and decay schemes for the corresponding levels in the ^{28}Si nucleus are proposed. (FR)

22856 ENERGY LEVELS OF ^{24}Na FROM THE $^{23}Na(d,p\gamma)^{24}Na$ REACTION. Ekstroem, P.; Tillman, J.; Carlen, L. (Univ. of Lund, Sweden). Nucl. Phys.; A210: No. 3, 458-464(1973).

Excited states in ^{24}Na have been investigated by means of the $^{23}Na(d,p\gamma)^{24}Na$ reaction at incident deuteron energies of 2.5 and 2.8 MeV. Excitation energies and γ-ray decay for levels up to 4.2 MeV have been determined from proton-gamma coincidence spectra obtained with a surface barrier detector and a Ge(Li) detector on-line with a computer. Two new levels at 3944 ± 2 and 4195 ± 3 keV excitation energies are reported. (auth)

22857 LIFETIMES AND BRANCHING RATIOS OF EXCITED STATES OF ^{24}Na. Smulders, P. J. M. (State Univ., Groningen, Netherlands). Nucl. Phys.; A210: No. 3, 579-589(1973).

The decay of ^{24}Na levels below 4.3 MeV excitation was studied by means of the $^{23}Na(d,p\gamma)^{24}Na$ reaction at $E_d = 2.45$ MeV. Gamma-ray spectra were measured at three angles, in coincidence with proton groups detected around 180°. Excitation energies, branching ratios and Doppler shifts were determined. Mean lives were obtained for the levels at 1341 keV (62 ± 15 fs), and 1846 keV (200 ± 50 fs). The 1347 keV level has $\tau > 3$ ps. For other levels above 1 MeV upper limits of ≈60 fs are set. In some cases spin restrictions follow. In particular $J = 2$ is assigned to the 1341 keV level. (auth)

22858 SPIN ASSIGNMENTS BY A HIGH SPIN SELECTIVE HEAVY ION REACTION. Klapdor, H. V.; Reiss, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys.; 262: No. 1, 83-94(1973).

The reaction $^{12}C(^{14}N,d)^{24}Mg$ is investigated at $E_{Lab} = 52$ MeV by means of a multigap magnetic spectrograph. Angular distributions of levels between 6.00 and 20.21 MeV are measured using nuclear track emulsions. By quantitative analysis of the angular distributions (FR DWBA and Hauser-Feshbach calculations), the reaction is shown to proceed almost completely via compound mechanism. The reaction is applied for selective excitation of high spin states in ^{24}Mg. Evidence is given by this example that under suitably chosen conditions a complex heavy ion reaction can be a powerful means for spin assignments at high excitation energies. (4 figures, 1 table) (auth)

22859 OPTICAL MODEL AND COUPLED-CHANNEL ANALYSIS OF 60-90 MeV DEUTERON SCATTERING FROM ^{24}Mg AND ^{89}Y. Hrehuss, G.; Kiss, A.; Knoepfle, K. T.; Mayer-Boericke, C.; Rogge, M.; Schwinn, U.; Tamura, T.; Turek, P. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 260: No. 3, 179-184(1973).

Angular distributions of deuterons scattered from ^{24}Mg and ^{89}Y in the angular range 12° — 100° have been measured at 60, 77 and 90 MeV deuteron energies. With some exceptions the elastic and inelastic data were found to be described consistently by the optical model approach and by coupled-channel analysis, respectively. Collective model features of ^{24}Mg are derived from the inelastic scattering results. (3 figures, 2 tables) (auth)

22860 INVESTIGATION OF ^{36}Ar WITH THE $^{35}Cl(p,\gamma)^{36}Ar$ REACTION. II. Angular Distributions and Shell Model Calculations. Hokken, G. A.; Hermans, J. A. J.; van Ginkel, A. (State Univ., Utrecht). Nucl. Phys.; A211: No. 2, 405-428(1973).

The angular distributions of primary and secondary γ-ray transitions at eight resonances in the $^{35}Cl(p,\gamma)^{36}Ar$ reaction have been measured with a 60 cm^3 Ge(Li) detector. The measurements lead to unambiguous J^π assignments for 17 states of ^{36}Ar and to J^π limitations for seven other states. A large number of γ-ray multipole mixing ratios were obtained. Many of the resonances are analogs of ^{36}Cl levels. The lifetime of the $E_x = 6.36$ MeV level has been determined as $\tau_m = 440 \pm 150$ fs. A simple shell model calculation has been performed to study the odd-parity levels of ^{36}Ar and ^{36}Cl. Coulomb displacement energies have been computed. Spectroscopic factors have been calculated and compared with the experimental data for the $^{35}Cl(d,p)^{36}Cl$ and $^{35}Cl(\tau,d)^{36}Ar$ reactions. (auth)

22861 6^- ANALOG-ANTIANALOG STATES OF ^{28}Si. Neal, G. F.; Lam, S. T. (Univ. of Alberta, Edmonton). Phys. Lett.; 45B: No. 2, 127-130(9 Jul 1973).

A resonance is observed in the $^{27}Al(p,\gamma)^{28}Si$ reaction at $E_p = 2876 \pm 2$ keV, which corresponds to an excitation energy of 14356 ± 2 keV. The 14.36 MeV level decays to a new level at 11577 ± 2 keV, which in turn decays to the known level at 9701.8 ± 0.5 keV. With previous information on the 9.70 MeV level and the present γ-ray angular distributions, obtained from singles spectra as recorded by a 40 cm^3 Ge(Li) detector, the spins of the three levels can be limited to $J = 5, 6$; $J = 6$; and $J = 5$, respectively. Transition strength arguments based on measurements of the strength of the 2876 keV resonance and the lifetime of the 11.58 MeV level indicate that the 14.36 MeV level has $J^\pi = 6^-$, $T = 1$ and that the 11.58 MeV level has $J^\pi = 6^-$, $T = 0$. (auth)

22862 SIZE AND SHAPE OF THE NUCLEAR DENSITY DISTRIBUTIONS OF ^{20}Ne AND ^{28}Si FROM 104 MeV ALPHA PARTICLE SCATTERING. Rebel, H.; Schweimer, G. W. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys.; 262: No. 1, 59-64(1973).

Measured differential cross sections for the scattering of 104 MeV α particles from ^{20}Ne and ^{28}Si are analyzed on the basis of a deformed folding model. Rms radii and values of the deformation parameters for the nuclear density distributions are extracted, and the effect of the size of the α particle is demonstrated. Previous discrepancies between (p,p') and (α,α') results are partly removed. (1 figure, 2 tables) (auth)

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Refer also to abstracts 22524, 22775, 22784, 22785, 22796, 22806, 22808, 22820, 22828, 22830, 22919, 22933, 22954, 22955, 23067, 23070, 23071, 23133, and 23137.

22863 (CEA-N-1600, pp 26-28) STUDY OF THE (^{7}Li,t) REACTION ON ^{40}Ca AND ^{54}Fe ISOTOPES AT LOW ENERGY. Cunsolo, A.; Lemaire, M. C.; Mermaz, M. C.; Quebert, J. L.; Sztark, H. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The ^{40}Ca(^{7}Li,t)^{44}Ti and ^{54}Fe(^{7}Li,t)^{58}Ni reactions were studied for ^{7}Li at 16 MeV. The selectivity of these reactions exhibits some similarity with that already observed in the (^{16}O,^{12}C) reaction. (auth)

22864 (CEA-N-1600, pp 29-32) COMPARATIVE STUDY OF (^{18}O,^{14}C), (^{16}O,^{12}C), (^{14}N,^{10}B), (^{12}C,^{8}Be) REACTIONS ON ^{54}Fe AND (^{18}O,^{14}C), (^{16}O,^{12}C) REACTIONS ON ^{90}Zr. Cassagnou, Y.; Faraggi, H.; Morrison, G.; Papineau, A. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

Four transfer reactions on the same target leading to the same final states are compared in order to study the role of the incident particle structure in these reactions. The cross section ratios of these four reactions completely differ from those expected from alpha pick-up reaction data. (auth)

22865 (CEA-N-1600, pp 33-34) IDENTIFICATION OF EXCITED STATES PRODUCED IN HEAVY-ION REACTIONS USING ELECTROMAGNETIC TRANSITIONS. Ballini, R.; Fouan, J. P.; Tellez, A. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The ^{12}C–gamma coincidences in the reaction ^{54}Fe(^{16}O,^{12}Cγ)^{58}Ni were measured with a position-sensitive telescope detecting the emitted ^{12}C at 45 ± 7.5 deg lab. angle in a 35-msr solid angle. The overall particle resolution was of the order of 750 keV. The gamma rays were detected with a 80 cm^{3} Ge-(Li) detector with 5 keV resolution. Some excited states are undoubtedly identified through known gamma transitions; specific deexcitation modes are found for some excited groups. (auth)

22866 (CEA-N-1600, pp 48-49) STUDY OF ROTATIONAL LEVELS OF ^{45}Ti USING A PICK-UP REACTION. Bianchi, L.; Blasi, P.; Foti, A.; Maurenzig, P. R.; Taccetti, N. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The rotational levels of ^{45}Ti were studied for excitation energies up to 1580 keV by using the ^{46}Ti(d,t)^{45}Ti reaction. The spectroscopic factors, extracted using DWBA calculations for the transitions to these positive-parity levels, are in agreement with those deduced using the Nilsson model. (auth)

22867 (CEA-N-1600, pp 102-103) STUDY OF THE ^{39}K(^{3}He,p)^{41}Ca REACTION AT 35.3 MeV. Bruge, G.; Chaumeaux, A.; Fortier, S.; Gales, S.; Guichard, A.; Laurent, M.; Schapira, J. P. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The ^{39}K(^{3}He,p)^{41}Ca reaction was studied at 35.3 MeV in order to investigate the high spin states expected from the $[d_{\frac{3}{2}}]^{-1}$ $[f_{\frac{7}{2}}]^{2}$ configuration. The data are being analyzed. Data were also obtained for the ^{39}K(^{3}He,d)^{40}Ca reaction. They agree very well with those of previous experiments at lower energy. (auth)

22868 (CEA-N-1600, pp 104-105) (^{3}He,d) AND (^{3}He,p) REACTIONS ON ^{42}Ca AND ^{50}Cr AT 35.3 MeV. Bruge, G.; Chaumeaux, A.; Fortier, S.; Gaillard, P.; Guichard, A.; Grossiord, J. Y.; Pizzi, J. R.; Gusakow, M. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The conjugate nuclei ^{44}Sc and ^{52}Mn were studied through the ^{42}Ca(^{3}He,p)^{44}Sc and ^{50}Cr(^{3}He,p)^{52}Mn reactions. The data are being analyzed. Data were also taken for the ^{42}Ca(^{3}He,d)^{43}Sc and ^{50}Cr(^{3}He,d)^{51}Cr reactions. They agree with the previous measurements at lower energies. (auth)

22869 (CONF-730312-(P2), pp 549-555) REACTION MECHANISM AND LEVEL DENSITY INFORMATIONS IN MULTI-NUCLEON TRANSFER REACTIONS. Kamitsubo, H.; Yoshie, M.; Kohno, I.; Nakajima, S.; Yamane, I.; Mikumo, T. (Inst. of Physical and Chemical Research, Saitama, Japan). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The excitation mechanism of the quasi-elastic process was studied in the reactions ^{52}Cr(^{14}N, ^{12}C), ^{52}Cr(^{14}N, ^{10}B), ^{52}Cr(^{14}N, ^{11}B), and ^{52}Cr(^{12}C, ^{9}Be). Angular distributions and energy spectra are shown. (LTW)

22870 (CONF-730312-(P2), pp 557-572) INTERFERENCE OF COULOMB AND NUCLEAR EXCITATIONS FOR A PROJECTILE EXCITED VIA INELASTIC SCATTERING. Katori, K.; Fink, C. L.; Morrison, G. C.; Yntema, J. L.; Zeidman, B. (Argonne National Lab., IL). Mar. 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Elastic and inelastic scattering of ^{7}Li and ^{18}O on several targets in the fp shell were studied using the Argonne tandem Van de Graaff at energies near the Coulomb barrier. Angular distributions for ^{7}Li + ^{56}Fe were obtained at bombarding energies between 18 and 24 MeV. The scattering of ^{18}O was measured at 44 and 56 MeV for ^{58}Ni and at ^{66}MeV for ^{68}Zm. (LTW)

22871 (CONF-730312-(P2), pp 573-580) SINGLE- AND MULTI-NUCLEON TRANSFER REACTIONS ON N = 28 NUCLEI INDUCED BY ^{14}N AND ^{12}C. Kohno, I.; Kamitsubo, H.; Nakajima, S.; Yamane, I.; Yoshie, M.; Mikumo, T. (Inst. of Physical and Chemical Research, Saitama, Japan). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

^{14}N and ^{12}C ions of 60, 70, and 90 MeV accelerated by a variable-energy cyclotron bombarded self-supporting targets of ^{52}Cr and ^{54}Fe. Emitted particles were detected and identified by a conventional counter telescope of ΔE and E detectors. Isotopes of C, B, and Be were well separated in ^{14}N experiments and those of B and Be in ^{12}C experiments. The overall energy resolution was about 400 keV. (LTW)

22872 (CONF-730312-(P2), pp 655-661) FINITE-RANGE COUPLED-CHANNEL BORN APPROXIMATION FOR HEAVY-ION TRANSFER REACTIONS. Low, K. S.; Tamura, T. (Argonne National Lab., IL). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The finite-range coupled-channel Born approximation was used to analyze the reaction ^{40}Ca(^{18}O, ^{20}Ne)^{38}Ar reaction. Two calculations were made, one with and the other without Coulomb excitations. Comparison is made with experiment, and generalizations are drawn. (LTW)

22873 (CONF-730312-(P2), pp 681-688) ELASTIC AND INELASTIC SCATTERING OF ^{16}O FROM ^{58}Ni. West, L.; Fletcher, N. R. (Florida State Univ., Tallahassee). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Optical model analysis of elastic scattering and DWBA analysis of inelastic scattering of ^{16}O from ^{58}Ni are discussed. (LTW)

22874 (CONF-730823-11) FISSION AND COMPLETE FUSION MEASUREMENTS IN ^{40}Ar BOMBARDMENTS OF ^{58}Ni AND ^{109}Ag. Gutbrod, H. H.; Plasil, F.; Britt, H. C.; Erkkila, B. H.; Stokes, R. H.; Blann, M. (Gesellschaft fuer Schwerionenforschung, Darmstadt (West Germany); Oak Ridge National Lab., Tenn.; Los Alamos Scientific Lab., N. Mex.; Rochester Univ., N. Y.). 1973. 15p. (SM-174/59). Dep. NTIS $3.00.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Thin targets of ^{58}Ni and ^{109}Ag have been bombarded with 197 and 288 MeV ^{40}Ar ions from the Berkeley SUPERHILAC. A particle telescope consisting of a gas proportional ΔE counter and a silicon surface barrier E detector was used to measure all reaction products ranging from elastically scattered argon ions to compound nucleus evaporation products. Fission fragments and transfer products were also detected. A good separation between fission fragments and other reaction products was possible in the case of the ^{109}Ag + ^{40}Ar reaction. Angular distributions were obtained from 4° to 180° in the laboratory system. Elastic scattering and a 252 Cf source were used to obtain energy and angular calibrations. The fission fragment angular distribution is characterized by a $1/\sin\theta$ function, and the integrated fission cross-section was found to be 300 and 600 mb for Ar + Ag at 197 and 288 MeV. Results have been interpreted in terms of a model in which fission competes with other modes of de-excitation of the compound nucleus, and in which the effects of angular momentum on the fission

barrier are taken into account. The implications of this conclusion are discussed. Comparisons are also made with models for the complete fusion cross section which are based on the contact configuration for the interacting two body systems. (auth)

22875 (JINR-P4-7131) QUASICLASSICAL CONSIDERATION OF THE LITHIUM SPLITTING REACTION IN THE NEAR-BARRIER ENERGY REGION. Titov, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The ^{6}Li breakup reactions in the near-barrier energy region are analyzed in the framework of quasiclassical variant of the strong coupling channel method. The dependence of the splitting cross sections on the Li structural parameters is studied as well as the role of nuclear interaction in the reaction mechanism. Comparison is made with the available experimental data. (auth)

22876 (LBL-1666, pp 106-107) STUDY OF ELEMENTARY PARTICLE EFFECTS IN SIMPLE HIGH-ENERGY NUCLEAR REACTIONS. Jacob, N. P. Jr.; Markowitz, S. S. May 1973.

In nuclear chemistry annual report, 1972.

22877 COUPLING OF A THREE-PARTICLE (HOLE) VALENCE-SHELL CLUSTER TO QUADRUPOLE VIBRATIONS (ALAGA MODEL): THE Z = 50 REGION: ODD Ag AND I ISOTOPES; AND THE Z = 28 REGION: ODD Mn AND Ga ISOTOPES. Paar, V. (Univ. of Copenhagen). Nucl. Phys.; A211: No. 1, 29-76(1973).

The present approach includes two important physical correlations: the interaction between single-particle degrees of freedom and the vibrational field and the Pauli principle for three particles or holes in the valence shell. No new parameters were introduced. In this way, both the explicit appearance of broken and promoted pairs and the anharmonicities from the neighboring doubly even nuclei are accounted for. The model is generally characterized by the coexistence of quasivibrational and quasirotational features. Typical quasirotational elements are the quasiband pattern and the I = j−1 anomaly, while a typical quasivibrational element is the multiplet structure. Both features are naturally introduced by the mechanism of the cluster field coupling. Nuclei with Z = 50 ± 3 and Z = 28 ± 3 are qualitatively discussed within the framework of the present approach. A detailed qualitative and quantitative description of the properties of low-lying states (energy spectra, electromagnetic properties, transfer reactions) as well as a comparison with experiment are given for ^{107,109}Ag, ^{127}I, ^{55}Mn, and ^{69}Ga, which are typical and well known representatives of odd Ag, I, Mn, and Ga nuclei, respectively. (auth)

22878 PROBLEM OF SINGLE-PARTICLE BINDING AND COLLECTIVE DEGREES OF FREEDOM OF NUCLEI. Zhivopistsev, F. A.; Lukashev, A. V.; El'tekov, V. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 2, 201-205(1973). (In Russian).

The nucleon form factors for ^{40}Ca, ^{90}Zr, and ^{208}Pb, resulting from excitation of the low-lying collective state 3$^-$, was investigated. It was shown that the matrix elements of the interaction of nucleons with the core, calculated in the phenomenological and microscopic models, are similar to each other for the nuclei studied. (tr-auth)

22879 PROTON SPIN FLIP AT 12 MeV FOR NUCLEI NEAR THE NEUTRON SHELL CLOSURE, N = 28. Ellis, J. L.; Hungerford, E. V. III; Sweeney, W. E. Jr. (Rice Univ., Houston, TX). Nucl. Phys.; A210: No. 3, 557-567(1973).

Spin-flip angular distributions for the nuclear pairs ^{48,50}Ti and ^{54,56}Fe have been measured using the (p,p'γ) correlation method. These data are compared to collective model DWBA calculations using a distorted spin-orbit potential of the full Thomas form. The spin-flip angular distribution data for ^{54}Fe exhibit two peaks of nearly equal magnitude while the data for ^{56}Fe and ^{48,50}Ti more closely resemble the usual single large peak at back angles predicted by DWBA calculations. (auth)

22880 STUDY OF THE GROUND STATE DOUBLET IN ^{57}Fe. van der Decken, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Goldschmidt, M.; Heusler, A.; Klapdor, H. V.; Reiter, W.; Rieck, D.; Saathoff, W.; Wiedner, C. A.; Dehnhard, D. Z. Phys.; 260: No. 3, 247-252(1973).

The ^{56}Fe(d,p)^{57}Fe reaction has been studied at an incident energy of about 10 MeV. The ground state doublet of ^{57}Fe has been resolved using the Heidelberg Q3D magnetic spectrograph and the Minnesota split-pole spectrograph. The ratio of the spectroscopic strengths (2J + 1)S for the transition to the first excited state at 14.4 keV excitation energy ($J^\pi = 3/2^-$) and the ground state ($J^\pi = 1/2^-$) has been determined to be 5.80 ± 0.5. This number is of special interest with respect to a possible deformation of the nucleus ^{57}Fe and in connection with the corresponding analogue resonances in ^{57}Co. (2 figures) (auth)

22881 INELASTIC ELECTROMAGNETIC FORM FACTORS OF ^{39}K AND ^{40}Ca NUCLEI. Vlasenko, V. G.; Afanas'ev, N. G.; Gol'dshtein, V. A.; Dementii, S. V.; Kuplennikov, E. L.; Ogurtsov, V. I.; Startsev, V. I. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 17: No. 6, 1124-1125(Jun 1973). (In Russian).

The values of the inelastic electromagnetic form factors of the ^{39}K and ^{40}Ca nuclei for the squared momentum transfer region $1\ F^{-2} \lesssim q^2 \lesssim 8\ F^{-2}$ are obtained from the experiments on quasi-free scattering of electrons by nuclei. The results obtained agree with the nuclear-shell-model calculations using one-particle oscillatory wave functions. (1 figure) (auth)

22882 GAMMA-RAY SPECTROSCOPY OF ^{48}Cr. Kutschera, W. (Technische Univ., Munich); Huber, R. B.; Signorini, C.; Blasi, P. Nucl. Phys.; A210: No. 3, 531-543(1973).

A study of low-lying states in the self-conjugate nucleus ^{48}Cr has been performed with the reaction ^{40}Ca(^{10}B,pnγ)^{48}Cr. Several techniques of γ-ray spectroscopy have been used: activity measurements, γ-ray angular distributions, γ-γ coincidences, p-n-γ triple coincidences, and recoil-distance lifetime measurements. The following level energies, spin-parity assignments, and lifetimes have been found: 752.4 ± 0.5 keV, 2_1^+, τ_m = 9.7 ± 2.6 ps; 1858.7 ± 0.7 keV, 4_1^+, $\tau_m = 1.5^{+2.0}_{-0.5}$ ps; 3532.7 ± 1.2 keV, (6_1^+); 4064.3 ± 1.3 keV, (≥4), τ_m < 60 ps. The 2_1^+ state in ^{48}Cr is found to have the lowest excitation energy and highest E2 transition strength (33 ± 9 W.u.) among the 2_1^+ states of even nuclei in the $1f_{\frac{7}{2}}$ shell. (auth)

22883 EFFECTIVE INTERACTIONS AND THE ^{40}Ca(p,p') REACTION. Satchler, G. R. (Oak Ridge National Lab., TN). Z. Phys.; 260: No. 3, 209-230(1973).

The excitation of the lowest 3$^-$ and 5$^-$ levels in ^{40}Ca is studied using a microscopic description. The long-range part of the Hamada–Johnston potential is shown to be a good effective interaction, especially when supplemented by a phenomenological imaginary term. Transition densities are constructed from hole–particle RPA wave functions normalized to give the correct electric transition rates. Various wave functions and other interactions are studied. Other features of the calculations are discussed. (10 figures, 1 table) (auth)

22884 NEUTRON CAPTURE GAMMA-RAY YIELDS IN IRON. White, J. E. (Oak Ridge National Lab., TN); Fu, C. Y.; Yost, K. J. Nucl. Sci. Eng.; 51: No. 4, 496-508(Aug 1973).

Gamma-ray yields as a function of neutron energy from thermal to 1 MeV for iron have been generated with a combined experimental and theoretical approach. The theoretical part is to a large extent statistical; however, parameters are introduced to compensate for the nonstatistical behavior. Experimental information used to evaluate these parameters are the branching ratios among discrete levels and the gamma-ray primary transitions from thermal and available resonance capture. A discussion of the implications of additional resonance capture yield data, which was made available after the completion of the calculation, is included. The results have been compared with integral experiments, and the agreement is favorable. Considerable variations in the capture gamma-ray yields as a function of incident neutron energy are noticed. (auth)

22885 DETERMINATION OF THE E2/M1 MIXING RATIO OF THE 122-keV TRANSITION IN ^{57}Co DECAY BY NUCLEAR ORIENTATION. Schoeters, E.; Silverans, R. E.; Vanneste, L. (Univ., Louvain, Heverle, Belgium). Z. Phys.; 260: No. 4, 337-340(1973).

The E2/M1 mixing ratio of the 122-keV γ-ray in the decay of ^{57}Co has been measured by a nuclear orientation experiment. In order to obtain a very accurate value, special care was taken to reduce all possible systematic errors. The final value is δ = −0.116 ± 0.001, from which we deduced the transition probabilities B(M1) = 0.0021 ± 0.0001 μ_N^2 and B(E2) = 0.00267 ± 0.00011 e^2b^2. (2 figures) (auth)

22886 PHOTOPRODUCTION OF ^{24}Na FROM NUCLEI WITH 13 ≤ Z ≤ 29. Jaerund, A. (Univ. of Lund, Sweden); Friberg, B.; Forkman, B. Z. Phys.; 262: No. 1, 15-24(1973).

The yields of the reactions NUCLEUS(γ,ypxn)^{24}Na have been measured for eleven elements with $13 \lesssim Z \lesssim 29$ at maximum bremsstrahlung energies 100 MeV ≤ $E_{\gamma\,max} \lesssim$ 1000 MeV. An exponential decrease with increasing Z of the mean cross section calculated from the yield data has been obtained. This Z-dependence fits well into the systematics of spallation product cross sections. (7 figures, 1 table) (auth)

22887 MECHANISM OF THE (^{3}He,t) REACTION. Toyama, M. (Tokyo Inst. of Tech.). Nucl. Phys.; A211: No. 2, 254-268 (1973).

The (^{3}He,t) reactions are investigated by means of the second-order perturbation method with the (^{3}He-α-t) process and the ordinary DWBA term. The analyses are performed on the data of ^{48}Ca(^{3}He,t)^{48}Sc(0^+, 2^+, 4^+, 6^+), ^{90}Zr(^{3}He,t)^{90}Nb(2^+, 4^+, 6^+, 8^+) and

^{46,48,50}Ti(^{3}He,t)^{46,48,50}V(0^+). The results show that the (^{3}He-α-t) process is an important process in these reactions and a very good agreement between observed and calculated cross sections is obtained. The energy dependence of the cross section of the ^{90}Zr(^{3}He,t)^{90}Nb(0^+) reaction is also discussed. (auth)

22888 STUDIES ON THE LEVEL SCHEME OF ^{52}Cr BY THE REACTION ^{51}V(p,γ)^{52}Cr. Klar, E. Dresden; Technische Univ. (1971). 85p. (In German).

Thesis.

The gamma spectra of four resonances in the reaction ^{51}V(p,γ)^{52}Cr have been measured. The primary decay schemes are derived and discussed within the framework of currently available models for analog resonances. (18 figures, 1 table) (GE)

22889 REACTION ^{39}K(n,γ)^{40}K. COINCIDENCE AND ANGULAR CORRELATION MEASUREMENTS BY MEANS OF A TWO-DIMENSIONAL MEASURING DEVICE. Goettel, P. Bonn; Univ., Bonn (1971). 98p. (In German).

Thesis.

$\gamma\gamma$ coincidence and angular correlation measurements on the reaction ^{39}K(n,γ)^{40}K have been carried out with a two-dimensional measuring device. In the decay scheme of ^{40}K, spins and parities could be assigned up to the 2.418-keV level. (16 figures, 7 tables) (GE)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 22524, 22768, 22815, 22845, 22859, 22870, 22876, 22877, 22886, 22919, 22927, 22954, 22955, 22956, 22958, 22989, 22991, 23126, and 23132.

22890 (AECL-4505, pp 11-13) DECAY OF THE NEW ISOTOPE ^{72}Kr. Schmeing, H.; Hardy, J. C.; Graham, R. L.; Geiger, J. S.; Jackson, K. P. (Univ. of Toronto). Apr 1973.

In Physics Division progress report, January 1, 1973–March 31, 1973.

22891 (CEA-N-1600, pp 108-109) OPTICAL POTENTIALS FOR THE SCATTERING OF 21 TO 29 MeV ALPHA PARTICLES BY MEDIUM WEIGHT NUCLEI AND ^{208}Pb. Bruge, G.; Chaumeaux, A.; DeVries, R.; Escudie, J. L.; Lemos, O. F.; Terrien, Y. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The elastic scattering of 21-, 23-, 25-, and 29-MeV alpha particles from ^{46}Ti, ^{50,52}Cr, ^{54,56}Fe, ^{58,60,62,64}Ni, ^{64}Zn and ^{208}Pb was measured in the angular range $35° \leq \theta_{c.m.} \leq 175°$. The ^{208}Pb data are completely smooth as a function of angle and energy. The data are being analyzed with the optical-model global search program GENOA to extract systematically varying optical-model parameters and look for anomalies in the backward-angle data. (2 figures) (auth)

22892 (CONF-730312-(P2), pp 403-412) SYSTEMATIC STUDY OF THE ^{88}Sr(^{16}O, ^{15}N) REACTION: EVIDENCE FOR RECOIL EFFECTS. Anantaraman, N.; Katori, K.; Koerner, H. J. (Argonne National Lab., IL). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Angular distributions for the ^{88}Sr(^{16}O, ^{15}N) reaction leading to the $2p_{\frac{1}{2}}$ and $1g_{\frac{9}{2}}$ states in ^{89}Y were measured at several incident energies below and above the Coulomb barrier. Comparison with no-recoil DWBA calculations reveals an energy-dependent normalization for the transition to the $2p_{\frac{1}{2}}$ state, indicating the increasing importance of recoil contributions at higher incident energies. (auth)

22893 (CONF-730312-(P2), pp 629-635) NUCLEON TRANSFER WITH OXYGEN IONS BELOW AND NEAR THE COULOMB BARRIER. Nair, K. G.; Blair, J. S.; Reisdorf, W. (Univ. of Washington, Seattle). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The back-angle excitation functions of the (^{16}O, ^{15}N) reaction on ^{88}Sr and ^{140}Ce and of the (^{16}O, ^{17}O) reaction on ^{140}Ce were measured near the Coulomb barrier. Elastic scattering excitation functions were also measured. (LTW)

22894 (CONF-730312-(P2), pp 663-667) INTERFERENCE BETWEEN COULOMB EXCITATION AND NUCLEAR EXCITATION FOR THE 2.73-MeV 3^- STATE IN ^{88}Sr. Videbaek, F.; Ulbak, K.; Hansen, O.; Christensen, P. R. (Univ. of Copenhagen). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Inelastic ^{16}O scattering to the 3^-, 2.73-MeV state in ^{88}Sr at 52-MeV bombarding energy is described. Angular distributions and excitation function are derived by DWBA calculation. (LTW)

22895 (LBL-1666, pp 41-43) FRAGMENT PRODUCTION IN ^{40}Ar-INDUCED REACTIONS ON A Cu TARGET. Thompson, S. G.; Moretto, L. G.; Jared, R. C.; Heunemann, D.; Gatti, R. C. May 1973.

In nuclear chemistry annual report, 1972.

22896 (LBL-1966) STUDY OF A FISSION-LIKE ENVIRONMENT IN REACTIONS WITH VERY HEAVY IONS. Moretto, L. G.; Heunemann, D.; Jared, R. C.; Gatti, R. C.; Thompson, S. G. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 24p. (CONF-730823-14). Dep. NTIS $3.25.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

The dynamical aspects of the later stages of fission can be studied in the broader context of those reactions where the collective degrees of freedom play a dominant role. The interaction of large heavy ions with nuclei provides an ideal tool to sample the conditions prevailing in a scission-like environment. For this purpose a program has been started to study the reactions between ^{40}Ar and various targets. Energetic particles produced in these reactions are observed at various angles by means of a counter telescope. The analysis of the data provides the atomic number of the emitted particles, their angular distribution and their kinetic energy distribution. The reactions between ^{40}Ar and both a Cu and a Ag target at 288 MeV bombarding energy show an impressive emission of particles ranging in atomic number from 1 to 25 and above, matched in variety only by the fission process itself. The angular distributions are mostly peaked forward with the exception of the fragments with atomic number close to 18 in the case of the Cu target, for which a cross section increasing with angle is observed. The Z distribution at various angles suggests that the system is relaxing along the mass asymmetry coordinate. In the case of the Cu target the charge distribution seems to drift toward lower Z while in the case of the Ag target the drift is in the direction of larger Z. This is consistent with the potential energy of two spherical liquid drops in contact and rigidly rotating. The kinetic energy distributions are gaussian-like and peak at energies close to the Coulomb energies of two touching spheres. Both the charge distributions and the kinetic energy distributions suggest the picture of a very viscous dynamical evolution dominated by the potential energy. This evidence is consistent with the assumption of a viscous dynamical process in the latter stages of fission. (auth)

22897 (UJF-2922-F) INVESTIGATION OF GAMMA-RAYS FROM THE RADIATIVE CAPTURE OF POLARIZED NEUTRONS BY ORIENTED NUCLEI ^{59}Co. Honzatko, J.; Sebek, J.; Kajfosz, J.; Stehno, J.; Kosina, Z.; Konecny, K. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). May 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Anisotropy of 21 primary γ-transitions following the radiative capture of thermal polarized neutrons in ^{59}Co oriented by an external magnetic field at the temperature 0.12°K was measured with the aim of determining the possible spins of the ^{60}Co excited states and the mixing ratios of both competing capturing states 3^- and 4^- for different transitions. Interpretation of the experimental results has been carried out in consideration of coherent interference of the two capturing states. (auth)

22898 MEASUREMENT OF THE THERMAL EFFECTIVE CROSS SECTION AND THE EFFECTIVE RESONANCE INTEGRAL OF COPPER AND TANTALUM USING THE PILE OSCILLATOR METHOD. Markovic, V.; Kocic, A. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Bull. Boris Kidric Inst. Nucl. Sci., Nucl. Eng.; 22: No. 1, 468(Sep 1971).

The effective cross sections of copper, tantalum, and adopted standards in both pure thermal neutrons and a reactor spectrum with a higher yield of epithermal components, were measured by the pile oscillator technique. The thermal cross sections of 3.85 ± 0.05 and 24.7 ± 0.2 barns and the resonance integrals for infinite dilution, without 1/v yield, of 2.0 ± 0.35 and 537 ± 18 barns for copper and tantalum, respectively, were obtained. (auth)

22899 SPINS OF LEVELS IN ^{70}Ga. Najam, M. R.; Carlson, L. E.; Davidson, W. F.; Zuk, W. M. (Australian National Univ., Canberra). Nucl. Phys.; A211: No. 1, 77-95(1973).

The level structure of the nucleus ^{70}Ga was studied by means

of the ^{70}Zn(p, nγ)^{70}Ga reaction (Q = −1.435 MeV). Levels in ^{70}Ga up to 1633 keV in excitation were selectively populated by varying the proton bombarding energy in the range of 1.7 to 3.2 MeV. The γ-rays associated with these levels were identified in singles spectra from their energies and their threshold behavior. Gamma-ray branching ratios were obtained and a decay scheme for ^{70}Ga comprising 58 transitions is presented. Angular distributions of de-exciting γ-rays were measured at proton bombarding energies close to threshold for the levels studied. Comparison of these distributions with the theoretical predictions of the compound nucleus statistical model has led to spin and parity assignments for the levels studied. (auth)

22900 LEVELS OF ^{83}Br FROM THE (α,p) REACTION. Bucurescu, D.; Dragulescu, E.; Duma, M.; Ivascu, M.; Popescu, D.; Semenescu, G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 3, 359-363(1973).

The ^{80}Se(α,p)^{83}Br reaction was studied at 20.5 MeV incident energy. Angular distributions were measured for strongly excited states up to 3.1 MeV, and l and J assignments were made by means of a zero-range DWBA calculation. (auth)

22901 CORRELATION COUNTING APPLIED TO THE DETERMINATION OF ABSOLUTE DISINTEGRATION RATES FOR NUCLIDES WITH DELAYED STATES. Lewis, V. E.; Smith, D.; Williams, A. (National Physical Lab., Teddington, Eng.). Metrologia; 9: No. 1, 14-20(1973).

The correlation counting method is extended to two-step cascade processes with relatively long-lived intermediate states. Expressions are given for the statistical uncertainties and deadtime effects. The technique is applied to the absolute standardization of ^{75}Se, ^{67}Ga, ^{67}Cu, and ^{85}Sr activities, and to the detection and estimation of afterpulses in liquid scintillation counting. (7 figures, 2 tables) (auth)

22902 HYPERFINE STRUCTURE, g(J) FACTORS AND LIFETIMES OF EXCITED $^2P_{\frac{1}{2}}$ STATES OF Rb. Feiertag, D.; zu Putlitz, G. (Univ., Heidelberg). Z. Phys.; 261: No. 1, 1-12(1973).

The hyperfine structure of the $6^2P_{\frac{1}{2}}$ and $7^2P_{\frac{1}{2}}$ state of ^{85}Rb and ^{87}Rb and of the $6^2P_{\frac{1}{2}}$ state of ^{87}Rb were investigated with optical double resonance at intermediate magnetic fields. The magnetic interaction constants, g(J) factors and lifetimes are determined. From the hfs coupling constants of the n^2P multiplets a 11.5% core polarization contribution to the magnetic hfs of states is obtained, which is found to be independent from the main quantum number n. The expectation values $\langle r^{-3}\rangle_j$ for the np valence electrons corrected for core polarization are compared with those derived from the ^2P fine structure separation. Good agreement is achieved for all np levels with the choice of $Z_j = Z - 3 = 34$ for the effective nuclear charge number. The nuclear quadrupole moments of ^{85}Rb and ^{87}Rb are rederived on the basis of this more improved treatment for the p-electron-nucleus interaction yielding $Q(^{85}Rb) = +0.274(2) \times 10^{-24}$ cm^2 and $Q(^{87}Rb) = +0.132(1) \times 10^{-24}$ cm^2 where the error does not include the remaining theoretical uncertainty of about 10%. (GE)

22903 STATES IN ^{86}Sr, ^{84}Sr, AND ^{87}Y POPULATED IN THE (p,t) REACTION. Montague, D. G. (Science Research Council, Chilton, Eng.); Ramavataram, K.; Chant, N. S.; Davies, W. G.; Kitching, J. E.; McLatchie, W.; Morton, J. M. Z. Phys.; 261: No. 2, 155-168(1973).

The (p,t) reactions on ^{88}Sr, ^{86}Sr and ^{89}Y have been carried out at a bombarding energy of 49.5 MeV. Some low-lying excitations in ^{86}Sr and ^{84}Sr associated with configurations of $1g_{\frac{9}{2}}$ and $2p_{\frac{1}{2}}$ neutrons have been identified. Levels populated to 4 MeV of excitation in the strontium nuclei and to 2.5 MeV in ^{87}Y have been studied in the present experiment. In the case of ^{87}Y most of the levels populated are of a complex nature. (5 figures, 8 tables) (auth)

22904 CORE EXCITATION IN ^{79}Br AND ^{81}Br. Chopra, R. C. (Tata Inst. of Fundamental Research, Bombay). Z. Phys.; 260: No. 4, 315-324(1973).

The E2 and M1 reduced transition probabilities between the low-lying levels in the case of ^{79}Br and ^{81}Br have been calculated in the core-excitation model. To account for the observed M1 transition probabilities admixture among the like spin states is considered. In addition, the ground state static moments have been computed. For the same amount of admixture among the like spin states, a good agreement with the experimental results is obtained, for both ^{79}Br and ^{81}Br. The results are compared with other existing theoretical calculations. From our analysis, we obtain the quadrupole moment of the first excited 2^+ state in the neighboring even–even nuclei. It is in good agreement with the value calculated on the basis of the anharmonic vibrational model. (2 figures, 2 tables) (auth)

22905 FAST NEUTRON SCATTERING FROM RUBIDIUM. Barnard, E.; Coetzee, N.; De Villiers, J. A. M.; Reitmann, D.; Van der Merwe, P. (Atomic Energy Board, Pretoria). Z. Phys.; 260: No. 3, 197-207(1973).

A study was made of the (n,n), (n,n'), and (n,n'γ) reactions which occur when a natural rubidium scattering sample is exposed to mono-energetic neutron fluxes of energies ranging from 120 to 1,910 keV. Total cross sections, elastic scattering angular distributions and excitation functions for inelastic scattering were measured with a neutron time-of-flight spectrometer. Results are compared with Hauser–Feshbach theory. A 40-cc Ge(Li) detector was used in the time-gated mode to measure γ-rays from the (n,n'γ) reaction. The latter measurements were used to refine and extend the energy level schemes derived from neutron spectroscopy. Several new levels were discovered in the low-lying (below 1900 keV) energy level spectra of ^{85}Rb and ^{87}Rb. Gamma decay schemes and branching ratios were determined for the low-lying levels of ^{85}Rb and ^{87}Rb. (6 figures) (auth)

22906 DECAY OF ^{76}Kr. Lode, D.; Pessara, W.; Ohlsson, H.; Roeckl, E. (European Organization for Nuclear Research, Geneva). Z. Phys.; 260: No. 4, 253-270(1973).

The decay properties of ^{76}Kr have been investigated using mass-separated samples produced by the Isolde facility. New information on energies, spins, parities and transition probabilities concerning levels in ^{76}Br is presented. No direct β-feeding of the ^{76}Br ground state was found, resulting in a spin–parity assignment of 1^- to this state. (5 figures, 5 tables) (auth)

22907 ^{88}Sr(d,np)^{88}Sr REACTION. Zaidi, S. A. A.; Hoffmann, G. W.; Coker, W. R. (Univ. of Texas, Austin). Z. Phys.; 260: No. R4, 329-336(1973).

The ^{88}Sr(d,np)^{88}Sr cross section has been measured at 170° for deuteron energies from 7.5 to 10.0 MeV, and the total ^{88}Sr(d,np) cross section obtained. The total cross section is compared with results of coupled-channel Born approximation calculations using both empirical and shell-model form factors to describe the decaying isobaric analog state. It is shown also that the new data and calculations are consistent with earlier ^{88}Sr(d,p)^{89}Sr data. (GE)

22908 INTERPRETATION OF HIGH ENERGY INELASTIC INTERACTIONS OF PIONS WITH HEAVY EMULSION NUCLEI. Eliseev, S. M.; Kohli, J. M. (Joint Inst. for Nuclear Research, Moscow). Nucl. Phys.; B59: No. 1, 128-140(1973).

An analysis of the basic characteristics of secondary particles created in the interaction of pions with heavy emulsion nuclei at the highest accelerator energies available is presented. Calculations were performed with an intra-nuclear cascade model using the Monte Carlo method, taking into account the "trailing effect." Emission of slow particles from the excited residual nucleus was calculated using Weisskopf's evaporation theory. The theoretical results were compared with experimental results at 17.2 and 60 GeV interactions. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 21314, 22156, 22524, 22768, 22775, 22820, 22874–22878, 22887, 22893, 22896, 22908, 22963, 23008, 23026, 23132, and 23303.

22909 (BNL-50383) EVALUATED NEUTRON CROSS SECTIONS FOR ^{107}Ag, ^{109}Ag, AND ^{133}Cs. Bhat, M. R.; Prince, A. (Brookhaven National Lab., Upton, N. Y.). Apr 1973. Contract AT(30-1)-16. 25p. (ENDF-163). Dep. NTIS $3.25.

The evaluation of ^{107}Ag, ^{109}Ag, and ^{133}Cs for the Evaluated Nuclear Data File, Version III (ENDF/B-III) is described. The energy range covered is from 10^{-5} eV to 1.5×10^7 eV. The choice of the experimental data used in the evaluation is discussed. These data were supplemented by the results of nuclear model calculations in energy regions where such data were not available. Excitation functions and resonance parameters are given. (3 figures, 5 tables) (RWR)

22910 (CEA-N-1600, pp 46-47) ELASTIC SCATTERING OF α PARTICLES AROUND 180 DEG AROUND THE COULOMB BARRIER. Badawy, I.; Charles, P.; Dost, M.; Fernandez, B.; Gastebois, J. 1972. (In French).

In Nuclear Physics Department annual progress report, October 15, 1971–September 30, 1972.

The elastic scattering of α particles was measured around 180 deg for energies near to the Coulomb barrier on ^{112}Sn, ^{114}Sn, ^{116}Sn, ^{118}Sn, ^{120}Sn, ^{122}Sn, ^{124}Sn, ^{144}Sm, ^{148}Sm, ^{150}Sm, ^{152}Sm, ^{204}Pb, ^{206}Pb, ^{208}Pb. An optical model is used to analyze the data. (FR)

22911 (CEA-N-1600, pp 49-52) STUDY OF THE STRUCTURE OF ^{147}Sm AND ^{148}Sm NUCLEI USING THE RESONANT SCATTERING OF PROTONS. Cassagnou, Y.; Heusler, A.; Lamehi-Rachti, M.; Levi, C.; Mittig, W.; Papineau, L. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Isobaric analogue resonances in ^{148}Eu between E_p = 9 and 11 MeV were identified by comparing the resonant excitation of low-lying states in ^{148}Sm to the ^{147}Sm(d,p) spectrum of Kenefick and Sheline. In the case of elastic proton scattering, the l values (l = 1 + 3 mixed) were determined, in spite of resonance effects of less than 15%. The similarity of the excitation functions of ^{144}Sm(p,p_0) and ^{147}Sm(p,p_0) suggests states around E_x = 2 MeV in ^{148}Sm to have $(f^4_{\frac{7}{2}})_{2^+,4^+,6^+}$ and $(f^3_{\frac{7}{2}}p_{\frac{1}{2}})_J$ structures. The structural determination of ^{147}Sm states is impeded by the considerable effect of configuration mixing on the spectroscopic amplitudes. The observation of inelastic resonance cross sections up to 0.5 mb/sr, however, indicates further investigations to be worthwhile. (auth)

22912 (CEA-N-1600, pp 97-99) UNBOUND ANALOGUE STATES OF Nb ISOTOPES OBTAINED BY THE (^{3}He,d) STRIPPING REACTION. Ashery, D.; Bruge, G.; Chaumeaux, A.; Finkel, G.; Yavin, A. I. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

An extension of a previous study of unbound analogue states in Tc isotopes is presented. The same methods are used. Over 20 analogue states in Nb isotopes were populated through the (^{3}He,d) reaction on Zr isotopes. The proton spectroscopic factors deduced from DWBA calculations for the analogue states populated in the (^{3}He,d) reaction are successfully compared with those found through the (d,p) reaction on the same targets for the parent states. (auth)

22913 (CEA-N-1600, pp 105-107) STUDY OF THE (^{3}He,dp) REACTION ON Zr AND Mo ISOTOPES. Ashery, D.; Bruge, G.; Chaumeaux, A.; Finkel, G.; Rouger, M.; Yavin, A. I. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

The (^{3}He,dp) reaction was studied on ^{92}Mo and ^{94}Mo and ^{90}Zr and ^{92}Zr. The analysis of the data is in progress. (auth)

22914 (CEA-N-1600, pp 109-112) MICROSCOPIC CALCULATIONS OF THE INELASTIC SCATTERING OF PROTONS BY THE COLLECTIVE LEVELS OF TIN ISOTOPES. Terrien, Y. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Microscopic calculations of the (p,p') cross sections of the low-lying 2^+ and 3^- collective levels in tin isotopes are presented. A nucleon–nucleon force and RPA wave functions are used. The proton and neutron transition densities are normalized in such a way that calculated values of both (p,p') cross sections and electromagnetic reduced matrix elements B(EJ) are in good agreement with the experimental ones. The proton and neutron transition densities truly existing in the nucleus are then compared. (auth)

22915 (CEA-N-1600, pp 113-114) INELASTIC SCATTERING OF 40-MeV PROTONS ON ^{92}Mo, ^{116}Sn, ^{120}Sn, AND ^{124}Sn NUCLEI. Buenerd, M.; Escudie, J. L.; Loiseaux, J. M.; Martin, P.; Terrien, Y.; Viano, J. B. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Results of inelastic scattering of 40-MeV protons on ^{92}Mo and ^{116}Sn, ^{120}Sn and ^{124}Sn are presented in connection with the calculations explained for Sn isotopes. (auth)

22916 (CEA-N-1600, pp 164-167) CONCLUSIONS MADE FROM THE ANALYSIS OF RESULTS ON THE INELASTIC SCATTERING OF ELECTRONS ON CLOSED SHELL EVEN–EVEN NUCLEI. Antoine, B.; Bellicard, J. B.; Gillet, V.; Leconte, P.; Normand, J. M.; Phan Xuan Ho; Sick, I. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

The inelastic scattering of electrons on N = 28 (^{50}Ti, ^{52}Cr, ^{54}Fe) and N = 50 (^{90}Zr, ^{92}Mo) nuclei and on three tin isotopes (^{116}Sn, ^{120}Sn, and ^{124}Sn) was studied. The experimental results are compared to those obtained with theoretical models. (auth)

22917 (CEA-N-1600, pp 203-204) STUDY OF THE GIANT RESONANCE OF THE TIN ISOTOPES. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

A systematic study of tin isotopes was undertaken in the giant dipole region. No significant structure was observed. (auth)

22918 (CEA-N-1600, pp 216-218) CORRELATIONS BETWEEN PARTIAL WIDTHS AND INTERMEDIATE STRUCTURE OF (n,γ) SPECTRA. Cauvin, B.; Jain, A.; Lottin, A. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

An integral method was used to search for correlation between partial radiative widths and neutron widths. Such a correlation was found in the 2^+ resonances of ^{121}Sb and the 1^+ resonances of ^{159}Tb, contrary to the Au and I resonances. (auth)

22919 (CEA-N-1634) Q TABLE FOR REACTIONS INDUCED BY LIGHT IONS (p,d,t,^{3}He,^{4}He). Delaunay, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1973. 30p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

A program is presented for the determination of Q values for reactions between stable targets and proton, deuteron, triton, ^{3}He and ^{4}He beams. (auth)

22920 (CONF-730312-(P2), pp 441-450) ^{90}Zr(^{18}O, ^{12}C)^{96}Mo REACTION. Bonche, P.; Cassagnou, Y.; Faraggi, H.; Jaffrin, A.; Legrain, R.; Morrison, G.; Papineau, A. (CEN, Saclay, France). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Energy spectra of the ^{90}Zr(^{18}O, ^{12}C)^{92}Mo reaction were measured at various energies from 51 to 62 MeV and at various angles. Angular distributions are backward peaked below the Coulomb barrier (51 MeV) and strongly peaked above it (56 to 62 MeV) near the graying angle. (LTW)

22921 (CONF-730312-(P2), pp 485-494) ^{18}O INDUCED TRANSFER REACTIONS NEAR THE COULOMB BARRIER ON Sm AND Yb ISOTOPES. Cassagnou, Y.; Lamehi-Rachti, M.; Levi, C.; Mittig, W.; Papineau, L. (CEN, Saclay, France). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

^{18}O-induced transfer reactions on ^{144}Sm and ^{152}Sm, to compare a spherical and deformed target nucleus, and on ^{170}Yb, ^{171}Yb, ^{174}Yb, and ^{176}Yb were studied. In addition to elastic and inelastic scattering, the reactions observed were (^{18}O, ^{12}C), (^{18}O, ^{14}C), and (^{18}O, ^{15}N). Energy spectra, angular distributions, and optimum Q-values are shown. (LTW)

22922 (CONF-730312-(P2), pp 669-673) ENHANCEMENT OF TWO-PROTON TRANSFER (^{18}O, ^{14}C) ON N = 82 NUCLEI. von Oertzen, W.; Bohlen, H. G.; Gebauer, B. (Max-Planck Institut fuer Kernphysik, Heidelberg). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Target nuclei with closed neutron shell N = 82 and open proton shells (^{140}Ce, ^{142}Nd, ^{144}Sm) corresponding to the analogous situation for neutrons in the tin isotopes (closed proton shell at Z = 50) were chosen to study one-proton, two-proton, and α-particle transfer reactions induced by ^{18}O. The energies were chosen in the vicinity of the Coulomb barrier to give optimum conditions with respect to the cross sections and the applicability of semi-classical concepts. Spectra were taken at three energies ranging from 63 to 66.5 MeV for each target and at three or four angles from 150 to 170°. (LTW)

22923 (CONF-730823-8) NEON-INDUCED FISSION OF SILVER. Plasil, F.; Ferguson, R. L.; Pleasonton, F. (Oak Ridge National Lab., Tenn.). 1972. 19p. (SM-174/71). Dep. NTIS $3.00.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Thin targets of ^{107}Ag were bombarded with ^{20}Ne ions ranging in energy from 110.4 to 165.6 MeV. Silicon surface barrier detectors were used to detect coincident pairs of fission fragments and to measure fragment kinetic energies. The fission excitation function, relative to Rutherford scattering, was obtained. A fragment angular correlation measurement was made at 165.6 MeV, and, within the limits of statistical uncertainties, the correlation was found to be symmetric with a full-width-at-half-maximum (FWHM) of 11°. The fission cross section, σ_F, was found to range from 1.06 mb at 110.4 MeV to 73.3 mb at 165.6 MeV. Calculations of σ_F have been made on the basis of a model in which fission competes with other modes of de-excitation of the compound nucleus, and in which the variation of the fission barrier B_f with angular momentum is taken into account. The barrier height and the ratio of the level density parameter for fission to the level density

parameter for particle emission, a_f/a_n, were treated as adjustable variables. It was not possible to obtain a fit to the measured excitation function on the assumption that the compound nucleus formation cross section, σ_{CN}, is equal to the total reaction cross section σ_R. For $\sigma_{CN} < \sigma_R$, however, it was possible to fit the data with a wide range of B_f and a_f/a_n combinations. At a bombarding energy of 165.6 MeV, fragment mass and total kinetic energy distributions were obtained from the data by means of an iterative center-of-mass transformation. The mass distribution was found to be symmetric, and the average total kinetic energy to be 87 MeV. Measured widths of the mass and total kinetic energy distributions were compared with the liquid drop model, which predicts the mass distribution to be broad (38 amu FWHM), and the total kinetic energy distribution to be narrow (14 MeV FWHM). The measured width of the mass distribution (36 amu FWHM) was found to be in good agreement with the liquid drop prediction, but the width of the kinetic energy distribution (22 MeV FWHM) is somewhat greater than that predicted by the liquid drop theory. (auth)

22924 (EURFNR-1098) PROGRESS ON NEUTRON CROSS SECTION MEASUREMENTS AT KARLSRUHE. Cierjacks, S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Jun 1972. 30p. (KFK-1676; CONF-720607-33). Dep. NTIS (U.S. Sales Only) $3.50.

From 10th annual American Nuclear Society conference; Las Vegas, Nevada, USA (18 Jun 1972).

Work performed under United States–Euratom Fast Reactor Exchange Program.

Recent measurements of technologically important nuclear data at the pulsed 3 MV Van de Graaff accelerator and the fast neutron time-of-flight spectrometer at the isochronous cyclotron are described. Mainly three types of experiments have been carried out at the Van de Graaff accelerator: Measurements of capture-to-fission cross section ratios, high resolution neutron total and neutron resonance capture cross sections, and determinations of fission cross sections. In the last two years, work at the fast neutron spectrometer concentrated on the measurement of γ-ray production cross section, (n,x) reaction cross sections, fission cross sections, and elastic scattering experiments at a few angles. To allow for the measurement of absolute partial neutron cross sections, two methods have been developed to accurately determine the fast neutron flux using the well known n-p cross section as a standard. The two methods are briefly described. Finally, a short review is given of the neutron data program adopted by Karlsruhe for the next two years. (GE)

22925 (LBL-1666, pp 12-15) ENERGY-LEVEL SYSTEMATICS OF ODD-MASS LANTHANUM ISOTOPES; A NEW COUPLING SCHEME. Leigh, J. R.; Nakai, K.; Maier, K. H.; Puehlhofer, F.; Stephens, F. S.; Diamond, R. M. May 1973.

In nuclear chemistry annual report, 1972.

22926 (LBL-1666, 17-19) COUPLING SCHEME RELEVANT TO HIGH ANGULAR MOMENTA AND INTERMEDIATE NUCLEAR DEFORMATIONS. Stephens, F. S.; Diamond, R. M.; Nilsson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

22927 (LBL-1666, pp 22-25) STATISTICAL DECAY OF GAMMA RAYS IN (n_{th},γ) REACTIONS. Nardi, E.; Moretto, L. G.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

22928 (LBL-1666, pp 37-40) STUDY OF THE FRAGMENTS EMITTED IN HEAVY-ION-INDUCED REACTIONS. Moretto, L. G.; Kataria, S. K.; Heunemann, D.; Jared, R. C.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

22929 (LBL-1666, pp 93-94) HEAVY-ION INDUCED SINGLE NUCLEON TRANSFER REACTIONS IN THE Zr–Mo REGION. Žisman, M. S.; Becchetti, F. D.; Harvey, B. G.; Kovar, D.; Mahoney, J.; Sherman, J. D. May 1973.

In nuclear chemistry annual report, 1972.

22930 (LBL-1666, pp 234-236) MAGNETIC MOMENT OF THE 6.9-HOUR ISOMER OF ^{95}Mo. Kaindl, G.; Bacon, F.; Shirley, D. A. May 1973.

In nuclear chemistry annual report, 1972.

22931 (LBL-1666, pp 238-240) NUCLEAR MAGNETIC RESONANCE ON ORIENTED ^{101m}Rh. Kaindl, G.; Bacon, F.; Mahnke, H. E.; Shirley, D. A. May 1973.

In nuclear chemistry annual report, 1972.

22932 (LBL-1686) DIRECTIONAL CORRELATIONS OF PARITY AND TIME-REVERSAL NON-CONSERVING RADIATIONS EMITTED FROM ORIENTED NUCLEI. Krane, K. S. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 56p. Dep. NTIS $5.00.

A recently-developed formalism for analyzing directional correlations of gamma radiations emitted from oriented nuclei is extended to include parity-violating and time-reversal-violating radiations. The generalized angular distribution coefficients needed for describing such radiations are expressed in terms of generalized F-coefficients, extensive tables of which are presented. (2 figures, 4 tables) (auth)

22933 (LYCEN-7301) ANNUAL REPORT, JANUARY 1973. (Lyon Univ. (France). Institut de Physique Nucleaire). 1973. 85p. (In French). Dep. NTIS (U.S. Sales Only) $6.25.

The various chapters deal with the following subjects: radioactivity and nuclear reaction spectroscopy; reaction mechanisms; nuclear physics theory; nuclear chemistry; and some applications of nuclear techniques (solid state physics). (FR)

22934 (LYCEN-7315) TWO NEUTRON HOLES STATES IN THE EVEN N = 80 NUCLEI. Meyer-Levy, M.; Lopac, V. (Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Recherches Nucleaires). Mar 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

Properties of the even N = 80 nuclei are calculated by coupling two neutron holes to the quadrupole vibrator. Spectra and transition probabilities are compared with the available experimental data. The structure of the quadrupole moment of the 2_1^+ state is discussed in terms of the individual neutron excitations; the properties of the negative parity states are also investigated. (auth)

22935 (UCRL-74791) NUCLEAR COEXISTENCE IN ODD MASS In(Z = 49) NUCLEI. Meyer, R. A.; Larsen, J. T.; Lanier, R. G. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Jun 1973. 7p. (CONF-730815-1). Dep. NTIS $3.00.

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973).

A possible qualitative explanation of a set of levels in odd-A In isotopes based on proton coupling to a Cd core is presented. Supporting experimental data is discussed. (JWR)

22936 LIFETIME MEASUREMENTS OF THE 341.2-keV LEVEL IN ^{131}Xe. Engel, H.; Gerst, E.; Schneider, H. (Univ., Giessen, Ger). Z. Phys.; 261: No. 4, 343-349(1973). (In German).

Lifetime measurements of two excited states in ^{131}Xe populated by the decay of ^{131}I have been carried out. Analysis of data, delivered from a delayed $\gamma-\gamma$-coincidence experiment with a Ge(Li)–plastic detector combination, resulted in the following values: $T_{\frac{1}{2}}$ of 341.2-keV level in ^{131}Xe: (2.15 ± 0.07) ns; $T_{\frac{1}{2}}$ of 404.8-keV level in ^{131}Xe: <0.5 ns. (3 figures) (auth)

22937 STUDY OF THE (p,d) REACTION ON ^{95}Mo AND ^{97}Mo. Cochavi, S. (Tel-Aviv Univ., Ramat, Israel); Moalem, A.; Ashery, D.; Alster, J.; Bruge, G.; Chaumeaux, A. Nucl. Phys.; A211: No. 1, 21-28(1973).

The reactions ^{95,97}Mo(p,d)^{94,96}Mo were studied at a proton energy of 26 MeV. Angular distributions were measured from 11 to 40° and compared with distorted-wave Born approximation calculations; l-values and spectroscopic factors were extracted for the low-lying states of ^{94}Mo and ^{95}Mo. The angular distributions of these states have a characteristic l = 2 shape. The ratios of the summed spectroscopic factors to the 0^+, 2^+ and 4^+ states are in good agreement with the $(2d_{\frac{5}{2}})^n$ neutron configurations. The 2^+ strength is strongly fractionated in both ^{94}Mo and ^{96}Mo. The 4^+ strength in ^{94}Mo is split among two states, whereas in ^{96}Mo it is concentrated in the second 4^+ state. (auth)

22938 DETERMINATION OF THE SIGN AND VALUE OF THE ^{119}Sn AND ^{121}Sb NUCLEAR CHARGE RADIUS. Kus'min, R. N.; Nikitina, S. V.; Kovaleva, S. K.; Dainyak, B. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 2, 235-237(1973). (In Russian).

The determination of the nuclear charge radius of ^{119}Sn and ^{121}Sb was made on the basis of the established linear dependence of the isomeric displacement on the concentration of Sn or Sb in alloys representing the Yum-Rozeri electron phase. The values obtained were $(\Delta R/R)_{^{119}Sn} = +(0.88 \pm 0.03) \times 10^{-4}$ and $(\Delta R/R)_{^{121}Sb} = -(4.3 \pm 0.7) \times 10^{-4}$. (JSR)

22939 EFFECT OF INDIRECT TRANSITIONS ON TWO NUCLEON TRANSFER BETWEEN HEAVY IONS AND THEIR Q-DEPENDENCE. Ascuitto, R. J. (Niels Bohr Inst., Copenhagen); Glendenning, N. K. Phys. Lett.; 45B: No. 2, 85-88(9 Jul 1973).

Strong contributions from indirect transitions are predicted which lead to rather broad flat angular distributions up to the grazing angle in contrast to the strong peak at the grazing angle usually expected in heavy ion reactions. The ratio of indirect to direct

amplitudes increases as the Q of the reaction departs from the optimum value. (auth)

22940 SPIN ALIGNMENT OF THE GROUND-STATE BAND LEVELS IN Nd AND Sm ISOTOPES EXCITED IN $(\alpha,2n\gamma)$ REACTIONS. Ejiri, H.; Shibata, T.; Shimizu, A.; Yagi, K. (Osaka Univ., Toyonaka, Japan). J. Phys. Soc. Jap.; 33: No. 6, 1515-1521 (Dec 1972).

Spin alignment of the ground-state band levels of ^{144}Nd, ^{148}Sm, ^{150}Sm and ^{152}Sm excited in $(\alpha,2n\gamma)$ reactions is studied in detail by measuring precisely the anisotropy of the intra-ground-state band gamma rays. The degree of the spin alignment increases with the increase of the spin of the ground-state band levels. It depends little on the bombarding energies, the reaction Q values and the structures of the low-lying levels. A simple expression is obtained to describe the degree of the spin alignment in (particle, $x\gamma$) reactions. (auth)

22941 PROPERTIES OF EVEN-EVEN NUCLEI WITH PROTON NUMBERS FROM 40 TO 50. Grigor'ev, E. P. (Leningrad State Univ.). Fiz. Elem. Chastits At. Yadra; 3: No. 2, 480-508 (1972). (In Russian).

The experimentally observed properties of even-even nuclei from zirconium (Z = 40) to tin (Z = 50) are considered. The energies of low-lying levels with identical spins and parities for different nuclei are compared between them and with the predictions of certain models. The data on the absolute and relative γ- and β-transition probabilities are given. The range of application of the vibrational model to the nuclei mentioned are indicated. Attention is paid to the existence of a deformation region which includes the neutron-rich isotopes of zirconium, molybdenum and ruthenium. (auth)

22942 SEARCH FOR WEAK TRANSITIONS IN THE DECAY OF ^{125}Sb AND ACCURATE GAMMA INTENSITIES. Gupta, J. B.; Singhal, N. C.; Hamilton, J. H. (Vanderbilt Univ., Nashville). Z. Phys.; 261: No. 2, 137-142(1973).

The weak transitions in the decay of ^{125}Sb have been investigated through gamma ray measurements with high-resolution x-ray and with large-volume Ge(Li) detectors. The 172.6, 178.8, and 198.5 keV gamma rays are confirmed, while others previously reported were not. Accurate intensities were obtained for the stronger transitions. The weighted averages of these intensities, which cover the range of 116 to 670 keV, are useful for calibration of Ge(Li) systems. (3 figures, 1 table) (auth)

22943 ABSOLUTE BRANCHING RATIO OF ^{141}Ba-^{141}La. Holub, R.; Choppin, G. R. (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem.; 35: No. 7, 2591-2592(Jul 1973).

Measurements have been reported previously of the half-lives and relative gamma intensities of the isobars of mass chain 141. The data did not include a value for the absolute branching ratio of the gamma ray of 0.190 MeV of ^{141}Ba. This value has now been measured by comparison with the known (48%) absolute branching ratio of the 0.145 gamma ray for ^{141}Ce-^{141}Pr β^- decay. The radiochemical procedure is described. The average value is found to be 56%. The overall error is estimated to be ±8%. (UK)

22944 BRANCHING RATIO OF ^{131}I. Benson, P. A.; Gee, H. Y.; Nathans, M. W. (LFE Corp., Richmond, CA). J. Inorg. Nucl. Chem.; 35: No. 7, 2614-2615(Jul 1973).

A number of samples containing mixed fission products were analyzed by gamma spectrometry with a Ge(Li) crystal coupled to a 2048-channel pulse height analyzer. The system was calibrated with $^{235}UO_2$ irradiated with thermal neutrons, that was analyzed radiochemically for several fission products having a range of gamma energies from about 0.1 to 2 MeV. Thus, the ^{131}I content was determined to better than ±10%. The ratio ^{131m}Xe/^{131}I was found to be 0.012 ± 0.001. (UK)

22945 PROPERTIES OF NUCLEI IN A NEW REGION OF DEFORMATION Z ≥ 54, N ≤ 76. Brinkman, G. F.; Myukhov, L. Fiz. Elem. Chastits At. Yadra; 3: No. 2, 366-391(1972). (In Russian).

In this review neutron deficient nuclei outside of the stability line and between neutron shells 50 and 82 are considered. Properties of these nuclei were investigated, mainly in (HI,xn) reactions, for even-even nuclei by spectroscopy of the ground state bands, by lifetime measurements of their first 2^+ states and by interpretation of isomeric states (for even-even and odd nuclei). Equilibrium deformations and single particle states were calculated. (auth)

22946 COULOMB INTERACTION AND REACTIONS BETWEEN COMPLEX NUCLEI. Kalinkin, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 387-413(1971). (In Russian).

Putting into operation of new heavy-ion accelerators capable of giving intensive beams of almost all nuclei of the periodic table will make it possible in the nearest future to investigate reactions proceeding between heavy nuclei. The interpretation of these reactions will give rise to a number of theoretical problems. For example, just now one extensively discusses the problem of a possible effect of the powerful Coulomb forces between nuclei upon the general dynamics of their collisions and the behavior of various processes. The results of the work on the related problems are summarized in the present review. These are, first of all, investigations dealing with the Coulomb field effects on the nuclear shape. It is shown that the dynamical deformation effects may lead not only to some essential changes in processes of the usual type, like elastic and inelastic scattering, transfer reactions, formation and decay of compound nuclei, but also to qualitatively new processes like Coulomb fission. (auth)

22947 MEASUREMENTS OF THE MAGNETIC MOMENTS OF SHORT-LIVED NUCLEAR STATES. Khrynkevich, A. I. (Inst. of Nuclear Physics, Krakow). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 355-385(1971). (In Russian).

A general review of methods used for measuring magnetic moments of short-lived nuclear states is given. Principles, advantages and limitations of the methods based on the Moessbauer effect and on angular correlations of nuclear radiations are presented in more detail, and some recent methodical refinements are described. (auth)

22948 MEASUREMENT OF LIFETIMES OF EXCITED STATES OF THE NUCLEI ^{121}Sb, ^{123}Sb, AND ^{125}Sb. Begzhanov, R. B.; Gladyshev, D. A.; Azimov, K. Sh.; Mukhammadiev, A.; Narzikulov, M. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 63-65(1973). (In Russian).

The lifetimes of some excited states of ^{121}Sb, ^{123}Sb, and ^{125}Sb were measured by the method of delayed coincidences by using the radioactive sources ^{121m}Te, ^{123}Sn, ^{123m}Sn, and ^{125m}Sn. The following results were obtained: $T_{\frac{1}{2}}$ (37 keV) ^{121}Sb = (2.96 ± 0.08) ns; $T_{\frac{1}{2}}$ (506, 573 keV) ^{121}Sb < 0.3 ns; $T_{\frac{1}{2}}$ (160 keV) ^{123}Sb = (0.60 ± 0.04) ns; $T_{\frac{1}{2}}$ (1089 keV) ^{123}Sb ≤ 0.2 ns; $T_{\frac{1}{2}}$ (332 keV) ^{125}Sb = (0.148 ± 0.010) ns. Transition probabilities were calculated from the experimental data. (1 figure, 1 table) (tr-auth)

22949 QUADRUPOLE MOMENT OF THE 535 keV STATE OF ^{133}La. Klemme, B.; Herzog, P.; Schaefer, G.; Folle, R.; Netz, G. (Univ., Bonn). Phys. Lett.; 45B: No. 1, 38-39(25 Jun 1973).

The quadrupole moment of the 535 keV $^3/_2^-$ state of ^{133}La has been derived from a time-differential perturbed angular correlation measurement in an environment of La metal. The effective electric gradient is known from a nuclear quadrupole resonance measurement with the ground state of ^{133}La. The result Q = 0.35 ± 0.03 b does not confirm a proposed shape isomerism. (auth)

22950 NEW CONFIRMATION OF THE QUENCHING OF NUCLEAR MATRIX ELEMENTS FOR β-DECAY IN THE N = 82 REGION. Szybisz, L. (Kernforschungszentrum, Karlsruhe, Ger.). Lett. Nuovo Cim.; 7: No. 13, 553-558(28 Jul 1973).

Hindrance effects of the nuclear matrix element extracted from experimental data have been observed corresponding to both the $^7/_2^- \rightarrow {}^5/_2^+$ β transition from ^{141}Ce and the charge-exchange E1 γ transition from the isobaric analog state in ^{141}Pr. A detailed analysis of the $^7/_2^- \rightarrow {}^7/_2^+$ β transition from the decay of ^{141}Ce is performed; the shape factor, longitudinal polarization, β-γ directional correlation, β-γ circular polarization as a function of energy and angle, β-γ directional correlation from oriented nuclei, electron emission from oriented nuclei, and partial lifetime are all taken into account. Theoretical expressions for the β observables are given. The theoretical β moments, obtained by considering for the radial integral the wave functions corresponding to the harmonic oscillator potential, are tabulated, along with the evaluated polarizabilities. Several ratios of certain of the polarizabilities are discussed. (1 figure, 3 tables) (RWR)

22951 E0 TRANSITION IN ^{106}Pd. Grigor'ev, E. P.; Zolotu A. V.; Sergeev, V. O. (Leningrad State Univ.). Yadern. Fiz.; No. 6, 1121-1123(Jun 1973). (In Russian).

The E0 transition between the 0^+ excited level (1133.9 keV) and the ^{106}Pd ground state was found in the decay of ^{106}Rh. The measurements were carried out using a magnetic β spectrometer of the $\pi\sqrt{2}$ type. The values of the quantity X = B(E0)/B(E2) = (2.1 ± 0.7) · 10^{-2} and of the E0-matrix element $|\rho|$ = 0.137 ± 0.025 were determined. The values of X and ρ are compared with the vibrational-model calculations. (2 figures, 2 tables) (auth)

22952 INELASTIC SCATTERING OF 50- AND 65-MeV ELECTRONS FROM Ce, La, AND Pr. Pitthan, R. (Technische Univ., Darmstadt, Ger.). Z. Phys.; 260: No. 4, 283-304(1973).

The reduced matrix elements for the ground-state transitions to the first 2^+, 3^-, and 4^+ states in ^{140}Ce and ^{142}Ce were deter-

mined by DWEA analysis. In the giant resonance region of Ce, La, and Pr three broad resonances at excitation energies of 9, 12, and 15 MeV have been found. They are interpreted as M1, E2, and E1 giant resonances. (10 figures, 3 tables) (GE)

22953 FREE INDUCTION DECAY WITH RADIATION DAMPING. I. General Treatment. Odehnal, M.; Petricek, V. (Inst. of Nuclear Physics, Rez, Czech.). Czech. J. Phys.; 23: No. 8, 798-804(1973).

The problem of the free induction decay of a two-level spin system in the presence of a strong coupling between a resonant circuit and the system is discussed under different experimental conditions. It is shown that under certain conditions the shapes of these signals are profoundly modified by this coupling. In some cases one obtains, after a pulse excitation of the system, several emission peaks of energy from the spin system having a population difference below inversion, creating some sort of "photon-bottleneck" or of "coherent echo". (auth)

22954 NEUTRON ACTIVATION CROSS SECTIONS: MEASURED AND SEMIEMPIRICAL. Alley, W. E.; Lessler, R. M. (Univ. of California, Livermore). Nucl. Data, Sect. A; 11: No. 8-9, 621-833(Jul 1973).

This paper is presented for those who wish a quick estimate of neutron reaction cross sections for stable or long-lived isotopes from Z = 1 to Z = 83. A graphical portrayal of cross sections from 0.025 eV to approximately 15 MeV for 778 neutron-induced reactions is given. Reactions are primarily of the (n,γ), (n,2n), (n,p), (n,α), and (n,pn) type. Some (n,n*), (n,3n), (n,2α), (n,αn), (n,t), and (n,He^3) reactions are included. Product half-lives are greater than 1 min and less than 10^6 yr. Reactions leading to metastable states are included where the half-lives of such states are of the order of seconds or more. The reliability of the curves varies considerably. Although some of the cross sections are well-known due to the number of data points available, most cross sections are necessarily approximations because of the present lack of data. Reliability is indicated by ratings A, B, C, and D. The Index to Cross-Section Curves gives the gamma energy (in MeV) emitted per disintegration for each reaction product. The cutoff date for data is August 1971.

22955 NUCLEAR DATA SHEETS: RECENT REFERENCES. Nucl. Data, Sect. B; 9: No. 6, 515-669(Jun 1973).

Recent References is a current guide to experimental nuclear physics papers, issued three times per year. The information is described by a key word string, from which a user should be able to tell whether the indexed paper contains results that are relevant to his interests. The present volume covers literature received by the Nuclear Data Project or assigned key numbers between the dates January 1, 1973, and April 30, 1973. Recent References contains an index to all experimental papers which contain information about specific nuclei, an index to all experimental papers which contain results from nuclear reactions, and a bibliography of experimental nuclear reaction and structure articles. (RWR)

22956 PEAK CROSS SECTIONS FOR (HI,xn) REACTIONS. Neubert, W. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Data, Sect. A; 11: No. 7, 531-552(Jun 1973).

The experimental peak cross sections and the corresponding ion-beam energies are presented for boron-, carbon-, nitrogen-, oxygen-, fluorine-, neon-, phosphorus-, argon-, and krypton-induced compound-nucleus reactions which are followed by neutron evaporation. The average energy available per emitted neutron shows a decrease with increasing mass number of the compound nucleus. A simple formula for this A dependence was derived from the data presented. References to the original papers are given. The cutoff date for literature search was June 1972. (3 figures, 1 table) (auth)

22957 INTENSITIES OF X RAYS EMITTED FROM RADIOISOTOPES. Okada, M. (Japan Atomic Energy Research Inst., Tokai). Radioisotopes (Tokyo); 22: No. 5, 266-270(May 1973).

X-ray intensities are presented for 161 single radioisotopes and for some decay chains in equilibrium. The data have been collected, not from original papers, but from the compilations of nuclear data. The arrangement is in order of the atomic number of the isotopes. (auth)

22958 (γ,γ') REACTIONS IN ^{89}Y, ^{115}In, AND ^{197}Au AT INTERMEDIATE ENERGIES. Forkman, B.; Janecek, P.; Jonsson, G. G.; Lindgren, K. (Lund Inst. of Tech., Sweden). Nucl. Phys.; A211: No. 2, 310-316(1973).

The yields of isomeric states in ^{89}Y, ^{115}In and ^{197}Au produced by the (γ,γ') reaction have been measured in the energy range 100–800 MeV by the activation method. From the yields the cross sections have been deduced. Large cross sections around the first pion resonance are found. The experimental results are compared to calculations based on the impulse approximation. (auth)

22959 INVESTIGATION OF THE DECAY OF EXCITED STATES IN ^{141}Ce BY THE NUCLEAR REACTION (d,pγ). Pingel, K. Heidelberg; Univ., Heidelberg (1971). 56p. (In German). Thesis.

The excited states in ^{141}Ce have been investigated below 3 MeV by means of (d,pγ) coincidence measurements. Spin assignments and branching ratios that seemed to be somewhat contradictory up to now could be definitively determined. In addition, γ transitions in ^{140}Pr and in ^{143}Ce have been studied, and a decay scheme of the low-lying states in ^{143}Ce is given. (18 figures, 8 tables) (GE)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 21972, 21975, 22225, 22524, 22849, 22898, 22910, 22918, 22919, 22921, 22954–22956, 22958, 22987, 23028, and 23082.

22960 (AECL-4505) PHYSICS DIVISION PROGRESS REPORT, JANUARY 1, 1973–MARCH 31, 1973. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Apr 1973. 77p. (PR-P-97). Dep. NTIS (U. S. Sales Only) $6.00. AECL $2.00.

Areas of study included are nuclear physics, neutron and solid state physics, theoretical physics, and mathematics and computation (applied). Nucleon–nucleon forces, magnetic properties of short-lived excited states, and properties of new isotopes were studied. Crystal structure of alloys and sulfides was investigated. Work on semiconductor detectors continued. Operation of computers and accelerators is reviewed. (RWR)

For title listing of selected papers see: 22890, 22961, 22962, 22985, and 22986.

22961 (AECL-4505, p 13) LIFETIMES OF HIGH SPIN ROTATIONAL STATES IN ^{156}Gd AND ^{152}Sm. Sie, S. H. (Queen's Univ., Kingston, Ont.); Ward, D.; Graham, R. L.; Geiger, J. S.; Andrews, H. R. Apr 1973.

In physics division progress report, January 1, 1973–March 31, 1973.

22962 (AECL-4505, pp 14-15) BRANCHING RATIOS FROM BETA BAND LEVELS IN ^{156}Dy AND ^{154}Gd IN THE BACKBENDING REGION. Andrews, H. R.; Ward, D.; Geiger, J. S.; Graham, R. L. Apr 1973.

In physics division progress report, January 1, 1973–March 31, 1973.

22963 (FEI-352) 3^+ STATE IN A PHENOMENOLOGICAL COLLECTIVE MODEL OF THE NUCLEUS. Budnik, A. P.; Seregin, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk, Fiziko Energeticheskii Institut). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the framework of the phenomenological collective model of the nucleus with potential energy dependent on the deformation coordinates β and γ, the position of the 3^+ level and the ratio of the reduced E2 transition probabilities $B(E2, 3_1 \rightarrow 2_1)/B(E2, 3_1 \rightarrow 4_1)$ are calculated for even–even nuclei. The results of the calculations are compared with experimental data. In the appendix is given a method for construction of the angular functions of the five-dimensional oscillator for $J \leq 5$; the matrix elements of the fundamental operators of the collective model are also calculated. (2 figures) (tr-auth)

22964 (LBL-1666) NUCLEAR CHEMISTRY ANNUAL REPORT, 1972. Hendrie, D. L.; Tsang, C. F.; Zalkin, A. (eds.). (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 446p. Dep. NTIS $10.60.

Work is reported in the following areas: physics of the nucleus (nuclear spectroscopy, radioactivity, and fission; nuclear reactions and scattering; nuclear theory), chemical and atomic physics (photoelectron spectroscopy; hyperfine interactions; atomic and molecular spectroscopy), physical, inorganic, and analytical chemistry (x-ray crystallography; radiation chemistry; physical and inorganic chemistry; applications of activation analysis methods), and instrumentation. Although many of the papers present data, they are rather brief, averaging about two pages in length. Thesis abstracts, a 31-page list of 1972 publications, and an author index complete the volume. (RWR)

For title listings of selected papers see: 20672, 20737, 20765, 20846, 20977, 21197–21199, 21972–21975, 22154, 22155, 22179, 22225–22227, 22408–22411, 22753–22756, 22798–22801, 22843–22846, 22876, 22895, 22925–22931, 22965–22971, 22990–22995, 23018–23021, and 23078–23082.

22965 (LBL-1666, pp 4-6) ALPHA SPECTROSCOPY OF ISOTOPES PRODUCED BY HIGH-ENERGY NUCLEAR REACTIONS. Bowman, J. D.; Hyde, E. K.; Eppley, R. E. May 1973.
In nuclear chemistry annual report, 1972.

22966 (LBL-1666, pp 19-22) FEEDING TIMES FOLLOWING (HI,xn) REACTIONS. Newton, J. O.; Stephens, F. S.; Diamond, R. M. May 1973.
In nuclear chemistry annual report, 1972.

22967 (LBL-1666, pp 136-139) RADIUS SCALING FOR DEFORMED NUCLEI. Hendrie, D. L. May 1973.
In nuclear chemistry annual report, 1972.

22968 (LBL-1666, pp 160-163) NUCLEAR ROTATIONAL ENERGIES IN DEFORMED EVEN-EVEN NUCLEI. Rasmussen, J. O.; Ma, C. W. May 1973.
In nuclear chemistry annual report, 1972.

22969 (LBL-1666, pp 163-167) NUCLEAR ROTATIONAL ENERGY EXPANSIONS FOR DEFORMED ODD-MASS NUCLEI. Rasmussen, J. O.; Alonso, J.; Ribbe, W.; Rezanka, I.; Needham, R. May 1973.
In nuclear chemistry annual report, 1972.

22970 (LBL-1666, pp 220-222) TEMPERATURE SHIFTS OF THE ENERGY OF THE 6.2-keV GAMMA RAYS OF ^{181}Ta. Kaindl, G.; Salomon, D. May 1973.
In nuclear chemistry annual report, 1972.

22971 (LBL-1666, pp 236-238) NUCLEAR QUADRUPOLE ALIGNMENT OF ^{180m}Hf AND ^{175}Hf IN HAFNIUM METAL. Kaindl, G.; Bacon, F.; Soinski, A. J.; Shirley, D. A. May 1973.
In nuclear chemistry annual report, 1972.

22972 HALF-LIFE OF ^{178m_2}Hf AND ITS NEUTRON CAPTURE PRODUCTION. Helmer, R. G.; Reich, C. W. (Aerojet Nuclear Co., Idaho Falls, ID). Nucl. Phys.; A211: No. 1, 1-6(1973).
The half-life of the half spin isomeric state in ^{178}Hf at >2.43 MeV was measured to be 31 ± 1 y. The cross section for production of this isomer in a thermal-reactor neutron spectrum was measured to be $(2 \pm 1) \times 10^{-7}$ b. The computation of this value assumes that the burn-up cross section of the isomer is <20 b, an assumption which is supported by the experimental data. (auth)

22973 BACKBENDING IN A SIMPLE STRETCHING MODEL. Ross, C. K.; Nogami, Y. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A211: No. 1, 145-156(1973).
The governor model of Trainor and Gupta is used to indicate that a rotor consisting of two equal mass particles interacting through a two-body potential V(r) may be considered as a rough approximation to a deformed rotating nucleus. By choosing V(r) appropriately and solving the two-body problem quantum mechanically, it is shown that the ground state band and the β-band for this system display properties similar to those recently obtained experimentally for rare-earth nuclei. This suggests that centrifugal stretching may be an important mechanism in producing backbending, and recent calculations of the nuclear deformation energy are used to speculate on the nature of this stretching. A prolate to oblate shape transition at high excitation energies is suggested as one possibility. The generalized variable moment of inertia model is applied to the ground state band of the rotor, and the corresponding "potential energy" is obtained. This quantity is shown to be very different than the true two-body potential energy, and indicates that it is difficult to extract nuclear deformation energies from the variable moment of inertia model. (auth)

22974 EFFECTS OF STRONG ROTATION-PARTICLE COUPLING ON THE ENERGY LEVELS OF TWO-QUASIPARTICLE SYSTEMS WITH POSSIBLE APPLICATION OF ^{184}Ir AND ^{186}Ir. Emery, G. T. (Univ. of Indiana, Bloomington); Hochel, R.; Daly, P. J.; Hofstetter, K. J. Nucl. Phys.; A211: No. 1, 189-197(1973).
The consequences of the availability of the [541↓] proton orbital in light even-mass Ir nuclei are examined. The structure of rotational bands in which the state of lowest energy is not the state of minimum angular momentum is described in terms of an effective decoupling parameter. The [541↓] assignment for the proton in the ground state configurations of ^{184}Ir and ^{186}Ir is seen to be plausible, and the level ordering in these nuclei may be largely determined by the properties of the [541↓] orbital stemming from the j = 9/2 spherical state, while the perturbing effects of a low-Ω neutron partner ([510↑] or [512↓]) should be relatively insignificant. Other interesting consequences of this description are also discussed. (auth)

22975 LEVEL STRUCTURE OF ^{184}Os FROM ^{184}Ir DECAY AND ^{185}Re(p,2nγ) IN-BEAM SPECTROSCOPY. Hochel, R. (Purdue Univ., Lafayette, IN); Daly, P. J.; Hofstetter, K. J. Nucl. Phys.; A211: No. 1, 165-188(1973).
Levels of ^{184}Os populated in the decay of 3.1 h ^{184}Ir and in the ^{185}Re(p,2nγ) reaction were investigated. The measurements included γ-ray singles, β^+ ray endpoint, conversion coefficient, β^+-γ coincidence and detailed γ-γ coincidence determinations. The results have established an extensive ^{184}Os level scheme, which includes well developed ground state, γ-vibrational and K = 3 octupole bands and which accommodates all the intense transitions observed in both the radioactivity and in-beam γ-ray measurements. Deviations of the level energies in the $K^\pi = 0^+$ and $K^\pi = 2^+$ bands and of the interband reduced transition probabilities from the predictions of the strong-coupling model are discussed in terms of the rotation-vibration interaction, and the systematics of the octupole vibrational excitations in even-mass W and Os nuclei are reviewed. It is concluded that the ^{184}Ir ground state configuration has a spin of 5, and that it contains large admixtures of K = 0 or K = 1 character. (auth)

22976 DETERMINATION OF THE SPIN DEPENDENT PART OF THE SCATTERING AMPLITUDE OF ^{165}Ho USING NEUTRON DIFFRACTION. Herpin, A.; Meriel, P. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris); 34: No. 5, 423-427(May 1973). (In French).
The nuclear magnetic properties of ^{165}Ho were studied using nonpolarized neutron diffraction at very low temperature (between 4.2 and 1.4°K). The observation of the first magnetic satellite revealed the nuclear polarization of holmium induced by the ordered magnetic structure and the hyperfine field. The magnitude and sign of the spin-dependent part of the scattering amplitude of holmium were determined. The value obtained was $a_+ - a_- = (-0.34 \pm 0.04) \times 10^{-12}$ cm. (FR)

22977 DE-EXCITATION OF EVEN-EVEN ISOTOPES OF Yb, Hf, AND W PRODUCED IN (p,xnγ) REACTIONS. Birattari, C.; Gadioli, E.; Grassi Strini, A. M.; Strini, G.; Tagliaferri, G.; Zetta, L. (Univ., Milan). J. Phys. (Paris); 34: No. 5, 345-356 (May 1973).
The population of ground state rotational bands in the even-even deformed nuclides ^{168}Yb, ^{168}Yb, ^{170}Hf, ^{172}Hf, ^{174}Hf, ^{178}W, and ^{180}W was observed in reactions induced by 18- to 57-MeV protons. Detailed calculations are performed on the basis of the statistical model of the compound nucleus reaction de-excitation process. The experimental results can be satisfactorily explained. The mean moments of inertia of the nuclei produced in the reactions are deduced, for an estimated residual excitation energy of 6 MeV, and found to amount to no more than 50% of the corresponding rigid sphere figures. The values obtained are compared, and shown to be in agreement with the predictions of the independent pairing model of Lang and Le Couteur. (FR)

22978 STUDY OF THE ^{182}W(t,p)^{184}W REACTION AT 20 MeV. Casten, R. F. (Brookhaven National Lab., Upton, NY); Hansen, O. Nucl. Phys.; A210: No. 3, 489-501(1973).
The ^{182}W(t,p)^{184}W reaction has been studied at 20 MeV. The outgoing protons were detected in an Elbek broad range magnetic spectrograph. Absolute cross sections and angular distributions were measured. Evidence for inelastic effects in the reaction mechanism was observed for the first excited 2^+ state, the 3^- level at 1221 keV and the 5^+ state at 1295 keV. The 0^+ level at 1002 keV was populated with ≈2% the ground state cross section. A 4^+ level at 1536 keV was observed with ≈50% the ground state cross section. Calculations of the absolute (t,p) cross sections to this and other states with known structure resulted in excellent agreement with the measured values. (auth)

22979 LEVELS IN ^{189}Os POPULATED IN THE DECAY OF ^{189}Re. Hofstetter, K. J. (Univ. of Kentucky, Lexington). Z. Phys.; 261: No. 2, 143-154(1973).
The excited level scheme of ^{189}Os as populated by the decay of 23.4-h ^{189}Re has been studied by use of Ge(Li) and Si(Li) detectors in the γ-ray singles and coincidence modes. The data confirm the presence of excited levels in ^{189}Os at 30.8 $J^\pi = (9/2)^-$, 36.2 $(1/2)^-$, 69.5 $(5/2)^-$, 95.2 $(3/2)^-$, 216.7 $(7/2)^-$, 219.4 $(7/2)^-$, 233.6 $(3/2)^-$, 275.8 $(5/2)^-$, 496.8 $(1/2^-, 3/2^+)$, and 599.8 $(1/2^-, 3/2^+)$ keV. The spin and parity assignments are based on multipolarities determined by internal conversion coefficient measurements and decay systematics. A decay scheme is established for ^{189}Re which accommodates 98% of the electromagnetic transition intensity. No evidence for the 150-d ^{189}Re isomer was found in this study. (4 figures, 1 table) (auth)

22980 MECHANISMS OF HIGH ENERGY NUCLEAR REACTIONS. Baechmann, K.; Neidhart, B.; Ross, E. (Technische Univ., Darmstadt, Ger.). Radiochim. Acta; 18: No. 3, 133-137 (1972). (In German).

In this contribution, conclusions as to the mechanism of formation are drawn from the recoil properties of products of the interaction of high-energy protons with complex nuclei. The discussion is based upon data obtained by the authors (tantalum with 300-MeV, 580-MeV, 19-GeV protons) and data from the literature. For spallation products a linear dependence on $\sqrt{(\Delta A)}$ is proved for the momentum. It is not possible with the data at hand to distinguish between nucleons knocked out and nucleons evaporated. However, the so-called F/B ratio can be used to draw conclusions on the fraction of the fast cascade as a function of proton energy. For products of average mass it must be assumed that fission, spallation and fragmentation contribute to the process of formation. (6 figures, 1 table) (auth)

22981 VARIATION OF NUCLEAR QUADRUPOLE MOMENTS DUE TO ROTATION CALCULATED WITH RESIDUAL ph AND pp INTERACTIONS. Meyer, J.; Speth, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1197-1202 (Jun 1973). (In Russian).

The variation of the charge and mass quadrupole moment, $\delta\langle Q\rangle$, due to rotation is calculated for even rare-earth nuclei, together with variation of the mean square radius, $\delta\langle r^2\rangle$. The calculations are made in the framework of the theory of finite Fermi systems, and involve residual interactions in the particle–hole and particle–particle channels. The relation between $\delta\langle Q\rangle$ and $\delta\langle r^2\rangle$ obtained from the liquid-drop model appears to be inapplicable in the general case. $\delta\langle Q\rangle$ exceeds the value expected from $\delta\langle r^2\rangle$, in agreement with the data. (2 tables) (auth)

22982 NUMBER-CONSERVING TREATMENT OF THE BCS–TAMM–DANCOFF APPROXIMATION FOR DEFORMED RARE-EARTH NUCLEI. Kusuno, S. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 260: No. 3, 231-246(1973).

The formulation for the exact number-conserving treatment of the BCS–Tamm–Dancoff approximation (NTDA) in deformed even nuclei is given. It is applied to the $K^\pi = 0^-$ octupole vibrations of rare-earth nuclei, and is also compared with the ordinary TDA or RPA method based on the Bogoliubov transformation, which has the defect of mixing of the particle number in the wave functions. The excitation energies and B(E3) calculated by NTDA method show rather stronger dependence on the Nilsson orbits than those calculated by the usual TDA or RPA methods, especially for N = 94 nuclei. (5 figures) (auth)

22983 DECAY OF ^{168}Ho TO LEVELS OF ^{168}Er. Kawade, K.; Yamamoto, H.; Tsuchiya, K.; Katoh, T. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 34: No. 4, 857-864(Apr 1973).

The decay of ^{168}Ho has been studied with Ge(Li), NaI(Tl), and plastic detectors in singles and in coincidence. Sources were prepared by the ^{168}Er(n,p)^{168}Ho reaction with 14.8 MeV neutrons. Thirty-three gamma-rays were observed and twenty-eight of them were assigned in a proposed decay scheme, including three new levels at 2192.7, 2254.4 and 2425.7 keV. The half-life was measured to be 2.98 ± 0.09 min. The observation of a 1.92 ± 0.10 MeV beta group in coincidence with a 821 keV gamma transition establishes the total beta-decay energy as 2.74 ± 0.10 MeV. There is good agreement between beta-decay branching ratios to the gamma band and predictions from the adiabatic symmetric-rotor model. A value of 0.0313 ± 0.0025 for the band-mixing parameter z_2 was calculated from the E2 branching ratios for transitions between the gamma band and the ground-state band in ^{168}Er. (auth)

22984 STUDY OF ENERGY LEVELS AND CORIOLIS COUPLING IN ODD-MASS WOLFRAM NUCLEI BY MEANS OF (d,p) AND (d,t) REACTIONS. Casten, R. F.; Kleinheinz, P.; Daly, P. J.; Elbek, B. Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Medd.; 38: No. 13, 3-66(1972).

The energy levels of ^{179}W, ^{181}W, ^{183}W, ^{185}W and ^{187}W have been investigated by means of (d,p) and (d,t) reactions. The deuteron energy was 12.1 MeV and the charged reaction products were analyzed in a magnetic spectrograph at 60°, 90° and 125°. The results established detailed level schemes and greatly improved the understanding of the level structure in these nuclei. All the N = 5 Nilsson orbitals in an energy range of about 4 MeV have been identified. In addition, several N = 6($i_{13/2}$) Nilsson states have been located by combining the present results with those of a concurrent (^{3}He,α) reaction study. A quantitative analysis of the Coriolis coupling of the N = 5 orbitals was performed. It was found that many gross discrepancies between the experimental cross sections and those calculated using the Nilsson model and the distorted-wave Born approximation could be eliminated or reduced by inclusion in the cross section calculations of the Coriolis interaction with reduced coupling matrix elements. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 22225, 22784, 22798, 22806, 22808, 22820, 22830, 22849, 22875, 22878, 22891, 22910, 22918, 22919, 22927, 22954–22956, 22963, 22965, 23028, 23086, 23112, and 23134.

22985 (AECL-4505, pp 14, 16) LIFETIME FOR THE FIRST EXCITED STATE IN ^{209}Pb. Haeusser, O.; Ward, D.; Olin, A.; Witthuhn, W. Apr 1973.

In physics division progress report, January 1, 1973–March 31, 1973.

22986 (AECL-4505, pp 16-18) NEW SHORTLIVED ALPHA EMITTERS OF THORIUM: ^{218,219,220}Th. Haeusser, O.; Witthuhn, W.; Alexander, T. K.; McDonald, A. B.; Milton, J. C. D.; Olin, A. Apr 1973.

In Physics Division progress report, January 1, 1973–March 31, 1973.

22987 (CEA-N-1600, pp 202) STUDY OF GIANT RESONANCES OF Re, Ir, AND Pt. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Partial and total photonuclear cross sections of Re, Ir, and Pt were measured in the giant dipole region. (auth)

22988 (CEA-N-1600, pp 218-219) SEARCH FOR A PYGMY RESONANCE IN THE RESONANCE CAPTURE SPECTRUM OF Au. Jain, A. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

The anomalous bump which is known to exist in the thermal γ-ray capture spectrum of gold does not show up in the resonance spectra above 80 eV neutron energy. It is thus attributed to Porter–Thomas fluctuations. (auth)

22989 (IEA-267) NUCLEAR ELASTIC AND INELASTIC SCATTERING OF IRON CAPTURE GAMMA RAYS FROM LEAD AND NICKEL. Bianchini, F. G. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

An experimental study of some highly excited individual nuclear levels near the particle threshold region was carried out employing capture gamma-rays from iron, through nuclear resonant scattering measurements. The experiments were performed at a direct-beam tube facility of the IEA-RI reactor. A large volume Ge(Li) detector installed in a rotating table was used to perform the measurements. The energy of the elastic and inelastic scattered gamma-rays, as well as the angular distribution of the elastically scattered gamma-rays from lead and nickel are presented. The spins of the resonant levels were determined and found to be in agreement with previous determination. (auth)

22990 (LBL-1666, pp 25-28) FISSION FRAGMENT ANGULAR DISTRIBUTIONS IN ^{4}He-INDUCED FISSION OF NUCLEI IN THE ^{208}Pb REGION. Moretto, L. G.; Gatti, R. C.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

22991 (LBL-1666, pp 43-44) X-RAY–GAMMA-RAY ANALYSIS OF HEAVY-ION REACTION PRODUCTS. Jared, R. C.; Nifenecker, H.; Moretto, L. G.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

22992 (LBL-1666, pp 90-93) EVIDENCE OF RECOIL EFFECTS IN HEAVY-ION TRANSFER REACTIONS. Kovar, D. G.; Harvey, B. G.; Becchetti, F. D.; Mahoney, J.; Nagarajan, M. S. May 1973.

In nuclear chemistry annual report, 1972.

22993 (LBL-1666, pp 95-96) STUDY OF THE TWO-PROTON TRANSFER REACTIONS: ^{208}Pb(^{12}C,^{10}Be)^{210}Po AND ^{208}Pb(^{16}O,^{14}C)^{210}Po. Becchetti, F. D.; Kovar, D. G.; Harvey, B. G.; Hendrie, D. L.; Homeyer, H.; Mahoney, J.; von Oertzen, W. May 1973.

In nuclear chemistry annual report, 1972.

22994 (LBL-1666, pp 117-119) NEUTRON TRANSFER IN REACTIONS BETWEEN SUPERCONDUCTING NUCLEI. Kleber, M. May 1973.

In nuclear chemistry annual report, 1972.

22995 (LBL-1666, pp 241-242) MAGNETIC MOMENTS OF THE 12^- STATES IN ^{196,198,200}Au. Bacon, F.; Kaindl, G.; Mahnke, H. E.; Shirley, D. A. May 1973.

In nuclear chemistry annual report, 1972.

22996 THEORETICAL STUDY OF T-VIOLATION IN ^{192}Pt. Blin-Stoyle, R. J.; Bezerra Coutinho, F. A. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys.; A211: No. 1, 157-164(1973).

A theoretical study is made of T-violation in nuclear γ-decay in terms of a phenomenological T-violating internucleon potential. The results are applied to experimental data obtained for γ-decay in ^{192}Pt and an upper limit is derived for the strength of the T-violating potential. (auth)

22997 DISTRIBUTION OF SINGLE-PARTICLE STRENGTHS IN THE NUCLEI ^{207}Tl, ^{207}Pb, ^{209}Bi, and ^{209}Pb. Ring, P. (Technische Univ., Munich); Werner, E. Nucl. Phys., A; A211: No. 1, 198-210(1973).

Within the theory of finite Fermi systems the distribution of single-particle strengths in the odd mass nuclei surrounding ^{208}Pb is calculated. The Dyson equation with an energy dependent mass operator is solved and the resulting single-particle propagator is analyzed. It turns out that the concept of quasiparticles used in this theory is very well justified for nearly all the states in the first and the second shells below and above the Fermi surface. (auth)

22998 MAGNETIC PROPERTIES OF SINGLE PARTICLE STATES IN THE Pb-REGION. Khanna, F. C.; Haeusser, O. (Chalk River Nuclear Labs., Ont.). Phys. Lett., B; 45B: No. 1, 12-14(25 Jun 1973).

The reaction matrices of Kahana, Lee, and Scott are used to calculate magnetic moments in the Pb region. Excellent agreement with experiment is obtained if contributions from mesonic exchange currents are included. (auth)

22999 MAGNETIC MOMENTS OF THE $[\pi h_{\frac{9}{2}}^2]8^+$ STATES IN Po ISOTOPES AND OF THE $[(\pi h_{\frac{9}{2}}^2)_{8+} \otimes \nu p_{\frac{1}{2}}^{-1}]\,1^-_{\frac{1}{2}}$ STATE IN ^{209}Po. Nagamiya, S.; Yamazaki, Y.; Hashimoto, O.; Nomura, T.; Nakai, K.; Yamazaki, T. (Tokyo Univ.). Nucl. Phys.; A211: No. 2, 381-392(1973).

The g-factors of the $[\pi h_{\frac{9}{2}}^2]8^+$ states in ^{204}Po and ^{206}Po have been determined to be 0.91 ± 0.04 and 0.915 ± 0.013, respectively, and the g-factors of the $[\pi h_{\frac{9}{2}}^2]8^+$ states in ^{208}Po and ^{210}Po and of the $[(\pi h_{\frac{9}{2}}^2)_{8+} \otimes \nu p_{\frac{1}{2}}^{-1}]1^-_{\frac{1}{2}}$ state in ^{209}Po have been remeasured to be 0.911 ± 0.011, 0.901 ± 0.014 and 0.897 ± 0.015, respectively. The stroboscopic resonance method was used in the experiment, in which the aligned isomeric states were populated by (particle, xn) reactions in microscopic beam bursts of a cyclotron. The results are discussed in terms of the first- and higher-order configuration mixings in nuclear wave functions. (auth)

23000 BINARY AND TERNARY FISSION OF THORIUM, LEAD, AND PLATINUM INDUCED BY 12.2 GeV PROTONS. Todorovic, Z.; Antansijevic, R.; Juric, M. (Institut za Fiziku, Belgrade). Z. Phys.; 261: No. 4, 329-335(1973).

The binary and ternary fission of Th, Pb and Pt induced by 12.2 GeV protons has been analyzed with a polycarbonate detector. The basic characteristics of the binary and ternary fission of the elements mentioned are given and corresponding values of the cross sections are determined. (GE)

23001 EXCITED STATES IN ^{195}Pt FROM THE DECAY OF 2.3 h ^{195g}Ir, 3.7 h ^{195m}Ir AND 183 d ^{195}Au. Jansen, J. F. W.; Faas, A.; Winter, W. J. B. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Z. Phys.; 261: No. 2, 95-116(1973).

The decay of two previously reported isomers in ^{195}Ir has been investigated with Ge(Li) and Si(Li) detectors by observing β and γ rays as well as conversion electrons in single and coincidence measurements. To about 30 of 85 observed transitions a multipolarity was assigned. The energies of the gamma rays from ^{195}Au were also determined accurately. The decay scheme of ^{195}Ir shows 13 new levels in ^{195}Pt between 389 and 931 keV. Probable spin and parity assignments could be made to most levels. The results are compared with those of a recent Coulomb excitation study, reaction work and theoretical calculations. (8 figures, 6 tables) (auth)

23002 K-SHELL CONVERSION COEFFICIENT OF THE 412 keV PURE E2 TRANSITION IN ^{198}Hg. El-Nesr, M. S.; Mousa, M. G. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 21: No. 3, 207-209(1973).

The K-conversion coefficient of the 412 keV E2 transition in ^{198}Hg has been determined by means of an iron-free double-focusing beta-ray spectrometer by using the internal–external conversion method. The result obtained, α_K (412) = 0.03035 ± 0.00045, is in excellent agreement with the theoretical value, α_K = 0.0302, for pure E2 transition as calculated by Rose and by Sliv and Band. (2 figures, 1 table) (auth)

23003 DIRECT AND SEMI-DIRECT RADIATIVE CAPTURES OF 14-MeV NEUTRONS BY NUCLEI. Kitazawa, H. (Tokyo Inst. of Tech.); Koyama, K.; Sakurada, K.; Yamamuro, N.; Karashima, S. Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 116, 11-22(Mar 1973).

The several formulas for numerical calculation of the nucleon radiative capture cross section, in the case of the nucleon intrinsic spin ½ and the target spin 0, are derived from the direct and semi-direct (or collective) models which have been independently developed by Brown, Clement et al. and Lushnikov et al. From these expressions, the radiative capture cross sections for 14 MeV neutrons of ^{208}Pb are theoretically calculated. It seems that the profiles of the capture gamma spectra are well interpreted by these models. The calculated cross sections are considerably smaller than those measured by the activation method. (auth)

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Refer also to abstracts 21196, 22225, 22524, 22775, 22954–22956, 23000, 23068, 23078, 23086, and 23487.

23004 (BNL-18128) EXPERIMENTAL FISSION BARRIERS FOR ACTINIDE NUCLEI. Back, B. B.; Britt, H. C.; Garrett, J. D.; Hansen, O.; Leroux, B. (Brookhaven National Lab., Upton, N. Y.). 1973. 30p. (CONF-730823-12; SM-174/201). Dep. NTIS $3.50.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Fission probability distributions are measured for a number of isotopes of Th, Pa, U, Np, Pu, Am, Cm, and Bk using (d,pf), (t,pf), (^{3}He,df), p,p'f), (^{3}He,αf) and (t,αf) reactions. The results along with previous data available from (d,pf) and (n,f) studies are analyzed with a statistical model and estimates are obtained for the heights, E_A and E_B, and curvatures, $\hbar\omega_A$ and $\hbar\omega_B$, of the two peaks of the fission barrier for a wide range of actinide nuclei. The statistical model used for the analysis of odd A and odd–odd nuclei includes competition between fission, neutron emission and gamma ray de-excitation in the decay of the compound nucleus. The results suggest that fission widths which are greater by about a factor of 4 than those calculated are necessary to reproduce the magnitude of the measured fission probabilities. The results show that E_A is roughly constant throughout this region and E_B decreases with increasing Z. An exception to the approximate constancy of E_A is in Cm where E_A drops by 1.0 MeV from ^{248}Cm to ^{250}Cm. In some cases an odd-even fluctuation of 0.30–0.50 MeV is observed in the experimental E_A values. (auth)

23005 (BNL-50388) ANALYSIS OF THE ^{239}Pu NEUTRON CROSS SECTIONS FROM 20 keV TO 20 MeV. Prince, A.; Drake, M. K.; Hlavac, P. (Brookhaven National Lab., Upton, N. Y.). Apr 1973. 44p. (ENDF-190). Dep. NTIS $4.00.

A systematic study has been made of the total and partial neutron cross sections for ^{239}Pu in the energy range from 20 keV to 20 MeV for ENDF/B-III. The analysis was based on experimentally measured neutron cross sections and angular distributions. An extensive series of nuclear model calculations were made and compared with available experimental data. Results from deformed nucleus calculations were combined in a consistent manner with compound nucleus calculations to obtain estimates of all partial neutron cross sections. These reactions include σ_T, σ_{el}, σ_{nf}, σ_{ny} (compound direct and semidirect), σ_{nn}, (comp), $\sigma_{nn'}$ (direct), $\sigma_{n,2n}$, $\sigma_{n,3n}$, $\sigma_{n,p}$, $\sigma_{n,d}$, $\sigma_{n,t}$, $\sigma_{n,\alpha}$. Direct inelastic excitation processes (due to the coupling of the first several rotational levels in the ground state) were found to be extremely important in interpreting the available experimental data. (auth)

23006 (CEA-N-1600, pp 206-207) PRELIMINARY STUDIES ON PHOTOFISSION. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Partial photoneutron and photofission cross sections were measured simultaneously and separately for ^{232}Th, ^{238}U, and ^{237}Np. A new data analysis technique was used. A special study of the competition between the fission and neutron exit channels GAMMA$_n$/GAMMA$_f$ was also undertaken. (auth)

23007 (CEA-N-1600, pp 212-214) STUDY OF NEUTRONS AND γ RAYS EMITTED IN FISSION. Frehaut, J.; Le Bars, M.; Michaudon, A.; Shackleton, D.; Trochon, J. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

It is shown that in ^{239}Pu resonances presenting a small fission width, the average number of neutrons emitted per fission is low

whereas the average number of γ ray photons emitted and the total γ-ray energy released are large. This is considered as experimental evidence of the (n,γf) process. (auth)

23008 (CEA-N-1600, pp 223-224) SPECTRA OF INELASTICALLY SCATTERED NEUTRONS. Krebs, J.; L'Heriteau, J. P.; Ribon, P. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Calculation of the spectrum of secondary neutrons assumes the knowledge of the resolved levels or the level density. The data are not always consistent and it may be difficult to fill the gap between the resolved levels and the energies where the statistical model is valid. Further, corrections to the Hauser–Feshbach theory have to be applied. (auth)

23009 (CEA-N-1600, pp 233-234) STUDY OF PROMPT GAMMA RAYS HAVING ENERGIES OF LESS THAN 1.5 MeV AND EMITTED BETWEEN 60 AND 180 ps AFTER FISSION. Albinsson, H.; Girard, J.; Ribrag, M. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Recent measurements have yielded information on gamma rays of half-lives of about 60 ps. It is concluded that these gammas, found in two energy groups of 200 and 380 keV, constitute the last transitions of the prompt-gamma deexcitation of the fragments. (auth)

23010 (COO-3080-3) CROSS SECTIONS AND RECOIL PROPERTIES OF XENON ISOTOPES FORMED IN 11.5 GeV PROTON BOMBARDMENT OF ^{238}U. Yu, Y. W.; Porile, N. T.; Warasila, R.; Schaeffer, O. A. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry; State Univ. of New York, Stony Brook. Dept. of Earth and Space Sciences). 1973. Contract AT(11-1)-3080. 24p. Dep. NTIS $3.25.

Partial cumulative yields and thick-target recoil properties of 14 xenon nuclides formed in the interaction of ^{238}U with 11.5-GeV protons and ranging from ^{122}Xe to ^{136}Xe were measured. Independent yields and recoil ranges were deduced with the aid of reported data. The isotopic yield distribution consists of two peaks with a broad region of near-constant yields between them. The recoil ranges exhibit the characteristic dropoff on the near-neutron-deficient side of stability. Comparisons with other isotopic and isobaric yield distributions and ranges of products in the same mass region are presented. (2 figures, 6 tables) (auth)

23011 (CPSR-272) PROPERTIES OF ISOTOPIC α-n AND γ-n NEUTRON SOURCES. Downs, W. E. (Atomic Energy of Canada, Ltd., Ottawa (Ontario). Commercial Products Div.). Jun 1970. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Isotopic neutron sources, because of their small size, reasonable cost, reliability, and ready availability are potentially useful for routine applications in industry. The properties and advantages of the most common α-n and γ-n sources are reviewed. These properties include half-life, gamma outputs, neutron yields, average neutron energy, and source size per Ci. Information is included on the size and cost of typical large α-n sources. The sources considered most practical from the point of view of the user are ^{241}Am–Be, ^{241}Am–^{242}Cm–Be, ^{210}Po–Be, ^{238}Pu–Be, Ra–Be (mainly of historical significance), and ^{124}Sb–Be. (LCL)

23012 (DP-MS-73-29) NUCLEAR CHARGE DISTRIBUTION IN FISSION: FRACTIONAL INDEPENDENT YIELD OF ^{135}Xe FROM THERMAL-NEUTRON-INDUCED FISSION OF ^{245}Cm AND ^{249}Cf. Harbour, R. M.; Troutner, D. E.; MacMurdo, K. W. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1973. Contract AT(07-2)-1. 18p. (CONF-730807-4). Dep. NTIS $3.00.

From 166th American Chemical Society national meeting; Chicago, Illinois, USA (26 Aug 1973).

Target foils containing ^{245}Cm or ^{249}Cf, prepared by electrodeposition on high-purity aluminum foils, were irradiated in the Savannah River Plant high-flux reactor. The ^{135}Xe activity was measured as a function of time after irradiation by counting its 249.6-keV γ-ray with a 45-cm^3 Ge(Li) detector. From these measurements, the fraction of the A = 135 mass chain produced directly as ^{135}Xe relative to the total production of ^{135}I plus ^{135}Xe was calculated. The measured fractional independent yield of ^{135}Xe from ^{245}Cm fission is 0.17 ± 0.02, and that from ^{249}Cf fission is 0.36 ± 0.03. These yields are compared with those of ^{135}Xe from thermal-neutron-induced fission of ^{238}U, ^{235}U, ^{239}Pu, and ^{241}Pu. (1 figure, 3 tables) (auth)

23013 (FEI-268) DELAYED NEUTRONS AND PHYSICS OF FISSION. Part 1. Maksyutenko, B. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 19p. (In Russian). INIS.

A novel mathematical method is proposed for resolving the decay curves of delayed neutrons resulting from the fission of ^{235}U by thermal neutrons. The method, in contrast to the least-squares method utilized heretofore, allows the separation of a larger number of pure precursors. A study of the charge distribution and the cumulative yields of fission fragments indicated that the method was useful for isolating the contributions of the precursors which had identical half-lives and for calculating the yields from short-lived groups. Precursor yields in a pure form were thus obtained for the isotopes of Br, Rb, and I. The half-life was examined as a function of the mass number and the energy of β decay. The values of the half-life of Rb isotopes were revised. (tr-INIS)

23014 (FEI-269) DELAYED NEUTRONS AND PHYSICS OF FISSION. Part 2. Maksyutenko, B. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 22p. (In Russian). INIS.

A method suitable for analyzing delayed neutron decay curves (see Part I) was applied to problems connected with the identification of precursors and their yields. (5 figures) (KSW)

23015 (HEDL-TME-73-31) LMFBR REACTION RATE AND DOSIMETRY 7th QUARTERLY PROGRESS REPORT, DECEMBER 1972–FEBRUARY 1973. McElroy, W. N. (Hanford Engineering Development Lab., Richland, Wash.). Mar 1973. Contract AT(45-1)-2170. 122p. AT.

This report was compiled at the Hanford Engineering Development Laboratory, operated by Westinghouse Hanford Company, a subsidiary of Westinghouse Electric Corporation, for the United States Atomic Energy Commission, Division of Reactor Development and Technology, under Contract No. AT(45-1)-2170. It describes technical progress made in the Interlaboratory LMFBR Reaction Rate Program during the reporting period. The following organizations contributed to this report: Aerojet Nuclear Company, Argonne National Laboratory, Brookhaven National Laboratory, Hanford Engineering Development Laboratory, Lawrence Livermore Laboratory, and National Bureau of Standards. (23 figures, 32 tables) (RWR)

For title of selected section see: 23016.

23016 (HEDL-TME-73-31, pp BNL.1-8) EVALUATED CROSS SECTION LIBRARIES. Magurno, B. A. (Brookhaven National Lab., Upton, NY). Mar 1973.

In LMFBR reaction rate and dosimetry 7th quarterly progress report, December 1972–February 1973.

23017 (JINR-E15-7362) INVESTIGATION OF PHOTONUCLEAR REACTIONS LEADING TO SPONTANEOUSLY FISSIONING ISOMERS. Gangrskii, Yu. P.; Markov, B. N.; Tsipenyuk, Yu. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

The excitation functions of the (γ,n) and (γ,γ′) reactions leading to the formation of the ^{239}Pu, ^{241}Pu, ^{240}Am, ^{242}Am and ^{243}Am spontaneously fissioning isomers have been measured. The experiments have been carried out using a 17-orbit microtron. A spark counter with pulsed feeding served as a fission fragment detector. From the excitation functions measured, the parameters of a two-humped fission barrier have been obtained and compared with other experimental results and theoretical calculations. (auth)

23018 (LBL-1666, pp 31-33) NEUTRON EVAPORATION FROM ^{252}Cf FISSION FRAGMENTS ON THE BASIS OF THE SHELL MODEL. Nardi, E.; Moretto, L. G.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

23019 (LBL-1666, pp 33-35) SIMULTANEOUS EMISSION OF TWO LIGHT CHARGED PARTICLES IN THE SPONTANEOUS FISSION OF ^{252}Cf. Kataria, S.K.; Nardi, E.; Thompson, S. G. May 1973.

In nuclear chemistry annual report, 1972.

23020 (LBL-1666, pp 35-37) SEARCH FOR EVEN–ODD EFFECTS ON THE KINETIC ENERGIES OF FISSION FRAGMENTS. Nifenecker, H. May 1973.

In nuclear chemistry annual report, 1972.

23021 (LBL-1666, pp 126-128) FISSION HALF-LIVES FOR HEAVY EVEN–EVEN NUCLEI. Moeller, P.; Randrup, J. May 1973.

In nuclear chemistry annual report, 1972.

23022 (LBL-1905) SIMULTANEOUS EMISSION OF TWO LIGHT CHARGED PARTICLES IN SPONTANEOUS FISSION OF ^{252}Cf. Kataria, S. K.; Nardi, E.; Thompson, S. G. (California Univ., Berkeley. Lawrence Berkeley Lab). Jun 1973. Contract W-7405-eng-48. 29p. (CONF-730823-4). Dep. NTIS $3.50.

From third symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

The emission of two light charged particles in the spontaneous fission of ^{252}Cf was observed and studied. Two particle telescopes were placed on the opposite sides of a strong ^{252}Cf source covered on both sides by platinum foils. The coincidences between the two telescopes were mainly of the type $^{4}He-^{4}He$, although $^{4}He-^{3}H$ events were also observed. The energy spectra of the detected particles—alphas and tritons—are similar in shape to the spectra of normal long-range particles, but the mean energies are lower by about 2 MeV. The mean energy of one alpha particle in the $^{4}He-^{4}He$ coincidences does not change as a function of the energy of the other particle. The angular correlation between these particles was also measured in another experiment (at five angles 180°, 90°, 66°, 45°, 35°) without particle identification. The overall emission rate of the coincident particles is approximately two per million binary fission events. The hypothesis of independent emission of these two particles seems to be consistent with most of the observed data. (6 figures, 5 tables) (auth)

23023 (LBL-1963) MEASUREMENT OF PROMPT GAMMA RAY LIFETIMES OF FISSION FRAGMENTS OF ^{252}Cf. Jared J. C.; Nifenecker, H.; Thompson, S. G. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 14p. (CONF-730823-13; SM-174/62). Dep. NTIS $3.00.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

The time of emission of the prompt gamma rays from the fission fragments of ^{252}Cf have been measured over a time range from approximately 1.0×10^{-10} to 2.0×10^{-9} seconds using the velocity and flight path of the fission fragment to determine the time. The ^{252}Cf source was deposited on a thin foil attached to a micrometer screw and located between two fission fragment detectors. The distance from the source to one of the fragment detectors was varied over a range from approximately 0.01 to 2.0 cm. A gamma ray detector was located close to the reference fragment detector and operated in coincidence with the fission events. The gamma rays associated with the stopped fragments were distinguished from those of the moving fragments on the basis of the known Doppler shift. Measurements were taken at various distances between the source and the detector. The measured fission fragment kinetic energies were used to calculate the masses of the stopped fragments. Thus the gamma ray spectra associated with the different fragment masses were obtained. The measured spectra were then used to obtain the intensities of the gamma lines at each distance. From these data it has been possible to obtain the energies and lifetimes of the electromagnetic radiation emitted by the fragments promptly after formation. Such data provide valuable information indicating values of the deformation parameters of the even–even isotopes; in particular the quadrupole moments calculated on this basis were found to agree with the theoretical values. (auth)

23024 (RFP-2062) PROTON-INDUCED FISSION OF URANIUM-238 AT MODERATE ENERGY. Miller, L. D.; Yaffe, L. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 3 Aug 1973. Contract AT(29-1)-1106. 18p. Dep. NTIS $4.00.

Independent and cumulative formation cross sections in the fission of uranium-238 (^{238}U) by protons of energy of 30 to 160 million electron volts (MeV) were determined for antimony isotopes of mass number 120 to 131. Described are charge-dispersion curves (Z_p = probable charge) constructed and corrected for the variation of the neutron-to-proton ratio of the most probable fission product N/Z_p, as a function of mass (A). The charge-dispersion curves show an asymmetry and are computer-fitted by two overlapping Gaussians. If the curves could be correctly interpreted by the two-mode fission hypothesis, the ratios of asymmetric to symmetric fission at 50 and 160 MeV would be 7.9 and 1.5, respectively. (auth)

23025 (SGAE-2115) DISCUSSION OF FISSION PRODUCT YIELD EVALUATION METHODS AND A NEW EVALUATION. Lammer, M.; Eder, O. J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Apr 1973. 26p. (CONF-730302-12). Dep. NTIS (U. S. Sales Only) $3.50.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

Reliable data on fission product yields are necessary for interpretation of gamma spectrometric measurements on spent fuel elements. Discrepancies among sets of fission yields recommended by different evaluators led to a detailed study of published experimental data. A new evaluation was performed. After a comprehensive description of the present state of experimental methods for obtaining fission product yields the previously adopted evaluation procedures are critically reviewed. An evaluation procedure is proposed which takes into account sources of experimental errors and accuracies of methods used. Examples of recently evaluated fission product yields for thermal fission of ^{233}U, ^{235}U and ^{239}Pu and for fast fission of ^{232}Th are presented. Data for ^{238}U fast fission and ^{241}Pu thermal fission are in preparation. auth)

23026 MAIN COMPONENTS OF THE DELAYED-NEUTRON PRECURSORS IN THE FISSION OF ^{235}U BY THERMAL NEUTRONS. Schuessler, H. D.; Herrmann, G. (Univ., Mainz). Radiochim. Acta; 18: No. 3, 123-133(1972). (In German).

Rapid radiochemical separation methods have been used to determine the main components of the delayed-neutron precursors in the fission of ^{235}U by thermal neutrons. The contributions of bromine and iodine isotopes and the total contribution of the non-halogen elements have been determined as well as the contributions of individual nonhalogen elements such as rubidium, cesium, and yttrium. A new delayed-neutron precursor, 0.8-sec ^{140}I, has been identified; and another one, 1.1 secs up $^{98,99}Y$, has been confirmed. (6 figures, 7 tables) (GE)

23027 NEUTRONS OF TERNARY FISSION OF ^{252}Cf AND THE PROBLEM OF OBSERVING ^{5}He. Graevskii, A. P.; Bochagov, B. A.; Chestnov, Yu. A. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 17: No. 4, 145-146(20 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 204-206(20 Feb 1973).

A time-of-flight spectrometer was used to measure the spectra of the neutrons of ternary fission of ^{252}Cf at angles 0, 90, and 180° to the emission direction of the long-range α particle. A difference was found between the spectra at 0 and 180°, and can be interpreted as a group of neutrons from the decay of ^{5}He. The neutron spectrum at 90° indicates that the mechanisms in binary and ternary fission of ^{252}Cf are identical. (auth)

23028 SPONTANEOUSLY FISSIONING ISOMERS. Polikanov, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 343-353(1971). (In Russian).

The available experimental data on the fissioning isomers of heavy nuclei were analyzed. The conclusion is drawn that the two-humped fission barrier model is consistent with the experimental results. The systematics of the half-lives for the fissioning isomers is given, and the further experiments are mentioned. (auth)

23029 ANOMALY OF THE (n,n'f) REACTION THRESHOLD. Fursov, B. I.; Kuprianov, V. M.; Smirenkin, G. N. JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 257-261(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 362-366(5 Apr 1973).

The dependence of the fission cross sections of ^{238}U, ^{239}Pu, ^{240}Pu, and ^{242}Pu on the neutron energy, E_n, was investigated experimentally in the range E_n = 1.5 to 7.5 MeV; and the dependence of the angular anisotropy of the fission of ^{240}Pu and ^{242}Pu on E_n, at E_n = 4.0 to 5.5 MeV. The reaction (n,n'f) was observed to have a noticeable probability appreciably below the threshold energy value known from the data on the fission cross sections in the (n,f) reaction. The effect increases with increasing charge of the fissioning nucleus. The investigated "anomaly" is interpreted within the framework of the two-hump barrier model as (n,n'f) reaction with emission of neutrons in the second well. (2 figures) (auth)

23030 DECAY OF ^{233}Np AND ^{231}Np. Weiss-Reuter, R.; Muenzel, H.; Pfennig, G. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 35: No. 7, 2145-2152(Jul 1973).

The decay of $^{233}_{93}Np$ and $^{231}_{93}Np$ has been studied by γ-ray spectroscopy. These isotopes decay predominantly by electron capture with half-lives of 36.2 and 48.8 min, respectively. Energies and relative intensities for 21 and 15 observed γ-ray transitions have been determined. Decay schemes are proposed. For $^{233}_{93}Np$ EC-branching intensities are given. (auth)

23031 MASS-YIELD DISTRIBUTIONS IN PHOTOFISSION OF ^{232}Th AND ^{238}U. Chattopadhyay, A.; Dost, K. A.; Krajbich, I.; Sharma, H. D. (Univ. of Waterloo, Ont.). J. Inorg. Nucl. Chem.; 35: No. 8, 2621-2637(Aug 1973).

The mass-yield distributions in photofission of ^{232}Th and ^{238}U at 25 to 40 MeV bremsstrahlung peak energies have been determined by direct γ-ray spectrometry for twenty-three nuclides and for five additional nuclides by simple radiochemical separations and subsequent γ-ray spectrometry. The mass yield at A = 135 can be described as "negative" fine structure in the mass-yield curve. The independent yields of ^{132}I, ^{133}I, ^{135}I, ^{126}Sb ($t_{\frac{1}{2}}$ = 12.5 days), ^{128}Sb (8.6 hr) and ^{136}Cs in ^{238}U indicate that the $Z_p(A)$ are 0.2 Z-units higher than those found in the thermal neutron fission of ^{235}U. (auth)

23032 CUMULATIVE KRYPTON AND XENON YIELDS FROM THE NEUTRON INDUCED FISSION OF ^{237}Np, ^{238}Np, ^{241}Am AND ^{242}Am. Tracy, B. L. (McMaster Univ., Hamilton, Ont.); Pleva, J. F.; Thode, H. G. (McMaster Univ., Hamilton, Ont.). J. Inorg. Nucl. Chem.; 35: No. 8, 2639-2651(Aug 1973).

The relative cumulative krypton and xenon yields in the mass ranges 83 to 88 and 131 to 136 have been measured by means of a mass spectrometer for the thermal neutron fission of ^{237}Np, ^{238}Np, ^{241}Am, and ^{242}Am and for the fast neutron fission of ^{237}Np and ^{241}Am. The xenon isotope spectrum from ^{238}Np has a fine structure similar to that of ^{235}U, but different from that of ^{241}Am. A correlation with the neutron–proton ratio of the fissioning nucleus is pointed out. The krypton yields indicate an upward shift in the position of the light mass hump for heavier fissile elements. For the thermal neutron fission of adjacent isotopes of the same element, variations in the mass yield curve are found to be very small. On the other hand, the mass yield curve from fast neutron fission shows a broadening and a "smoothing out" of fine structure in comparison with thermal neutron fission. (auth)

23033 DIRECT REACTIONS IN INTERACTION OF ^{22}Ne WITH ^{232}Th. Artyukh, A. G.; Vil'chinski, Ya.; Volkov, V. V.; Gridnev, G. F.; Mikheev, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1126-1133(Jun 1973). (In Russian)

The ^{232}Th nucleus was bombarded by 174-MeV ions of ^{22}Ne. The $\Delta E-E$ technique was used to obtain the angular distributions, energy spectra, and production cross sections of fragments with atomic numbers $3 \leq Z \leq 12$ formed in direct reactions. (3 figures, 2 tables) (auth)

23034 NEW APPROACH TO THE SEARCH FOR DISTRIBUTION OF THE DELAYED-NEUTRON PRECURSORS. Tarasko, M. Z.; Maksyutenko, B. P. Yadern. Fiz.; 17: No. 6, 1149-1155 (Jun 1973). (In Russian)

Instead of the usual description of the decay curve of delayed neutrons with a limited (given) number of parameters, there is considered a description using an infinite set when only the interval of half-lives is given. The problem is solved by the least oriented divergence method. The distributions obtained show the possibility of resolving the contributors. The method may be applied to analyze any exponential dependence. (3 figures, 1 table) (auth)

23035 CHARACTERISTICS OF FRAGMENTS FROM FISSION OF THE COMPOUND NUCLEUS ^{236}U INDUCED BY NEUTRONS AND α-PARTICLES. Pavlov, A. F.; Okolovich, V. N.; D'yachenko, P. P.; Kuz'minov, B. D. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 17: No. 6, 1143-1148(Jun 1973). (In Russian).

The experimental data on the energy and mass distributions of fragments produced in fission of ^{236}U in the reactions ^{232}Th + α and ^{235}U + n are reported for compound-nucleus excitation energies from 18 to 30 MeV. The data obtained are analyzed using the existing theoretical considerations. It is noted that the observed differences in the characteristics of the fragments from the reactions in question may be qualitatively due to the redistribution of the partial contributions from fission with different numbers of preliminary emitted neutrons. (4 figures) (auth)

23036 MEASUREMENTS OF LOW ENERGY GAMMA RAYS FOLLOWING THERMAL NEUTRON CAPTURE IN ^{235}U. Schindler, W. J.; Fleck, C. M. (Atominstitut, Vienna). Atomkernenergie; 21: No. 27, 136-138(1973).

The low-energy γ rays were detected in a Ge(Li) detector; an enriched target of ^{235}U was used. The evaluation of singles and concidence spectra leads to some new transitions. Spin and parity of the 1,342-keV level and a level at 1,383 keV are deduced. (2 figures, 1 table) (auth)

23037 EXPERIMENTAL STUDY OF TERNARY FISSION OF ^{235}U WITH THERMAL AND RESONANCE NEUTRONS. Bischof, J. (Inst. of Nuclear Physics, Rez, Czech.); Dlouhy, Z.; Kvitek, J.; Popov, Yu. P. Czech. J. Phys.; 23: No. 8, 809-816(1973).

The alpha particle spectra from ternary fission of ^{235}U were investigated in the thermal and the resonance neutron energy regions. The resonance neutrons were obtained by passing the reactor neutron flux through a boron filter. A silicon surface barrier detector-telescope technique for alpha particle detection was used. In the resonance neutron energy region the ratio $\langle \Gamma_{\alpha f}/\Gamma_f \rangle$ was found to be 1.02 ± 0.2 times the value of $\sigma_{\alpha f}/\sigma_f$ in the thermal region. The nonGaussian tail of the LRA energy distribution was observed. (auth)

23038 STATISTICAL CALCULATION OF FISSION. Okamoto, H.; Nakahara, H.; Nishi, T. (Kyoto Univ., Uji, Japan). J. Phys. Soc. Jap.; 34: No. 3, 588-595(Mar 1973).

Calculation of fission fragment distributions based on Fong's statistical theory was carried out for the case of ^{241}Am thermal neutron fission using Myers and Swiatecki's mass formula and a phenomenological level density formula, originally developed by Gilbert and extended for deformed nuclei by the present authors. The results show that Fong's statistical theory with the now attainable knowledge on mass and level density, can only account for narrow asymmetric mass peaks centered around $A \simeq 108$ and 134. The present results are in good agreement with those calculated by Ignatyuk with a microscopic approach. Other physical quantities associated with the fission reaction, such as kinetic energy distribution, charge distribution, and total excitation energy distribution at scission configuration are given. A comparison was also made among various approaches for level density formulation. (auth)

23039 RECENT STUDIES ON NUCLEAR FISSION. Katase, A. (Kyushu Univ., Fukuoka). Nippon Genshiryoku Gakkaishi; 15: No. 4, 220-227(Apr 1973). (In Japanese).

A review is presented on the recent studies on nuclear fission. The influence of the nuclear shell on the potential energy surfaces of the deformed heavy nuclei is discussed. Some results of the two-center shell model are shown. The stability of the superheavy nuclei, their production using heavy ion reactions, and heavy-ion fission are discussed. The emission of light nuclei in fission is noted as an important phenomenon for the study of nuclear fission. (auth)

23040 CALCULATION OF THE PROMPT GAMMA ENERGY OF INDIVIDUAL FISSION FRAGMENTS FROM THE PROMPT NEUTRON NUMBERS. Mukherji, S.; Lal, K. B.; Sharma, T. (Indian Inst. of Tech., Kanpur). Aust. J. Phys.; 26: No. 3, 279-289(Jun 1973).

Approximate calculations of the prompt γ-ray energies of fission fragments and the total kinetic energies of different fragment pairs have been made on the basis of a liquid-drop model. In addition, reliable estimates of the quantum energy for collective quadrupolar vibration have been used to calculate the number of prompt γ-ray quanta emitted by the fragments from the thermal-neutron-induced fission of ^{235}U. There seems to be good agreement with the available experimental data. About 30 pairs of fission fragments from the thermal-neutron-induced fission of ^{233}U, ^{235}U, and ^{239}Pu and the spontaneous fission of ^{252}Cf have been included in this preliminary treatment. (auth)

23041 MEASUREMENTS OF α FOR ^{235}U AND ^{239}Pu AT 2 keV. Dvukhsherstnov, V. G.; Kazanskii, Yu. A.; Furmanov, V. M. At. Energ. (USSR); 33: No. 1, 577(Jul 1972). (In Russian).

This paper was summarized as paper No. 596/6584 with full copy held by TIC.

A scintillation spectrometer with n-γ discrimination was used to measure the capture-to-fission ratios of ^{235}U and ^{239}Pu for 2-keV neutrons. The results are compared with previous data. (JWR)

23042 MULTINUCLEON TRANSFER REACTIONS IN THE ^{232}Th + ^{22}Ne SYSTEM. Artukh, A. G.; Gridnev, G. F.; Mikheev, V. L.; Volkov, V. V.; Wilczynski, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A211: No. 2, 299-309 (1973).

Energy spectra of 58 light particles ($Z = 3$-12) produced in the bombardment of ^{232}Th with 174 MeV ^{22}Ne ions were measured. The kinematics of the two-body reactions leading to the production of these particles is examined in the framework of the model of Siemens, Bondorf, Gross and Dickmann. The phenomenological systematics of the cross sections, covering the whole set of the experimental data, is presented. (auth)

Nuclear Theory

Refer also to abstracts 22629, 22673, 22761, 22872, 22926, 22933, 22963, and 22964.

23043 (BARC-663) NUCLEAR CROSS-SECTION CALCULATIONS USING R-MATRIX. Balakrishnan, M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

A brief review of R-matrix theory is presented. A computer program for the R-matrix analysis of alpha elastic scattering on ^{6}Li is described. The program was written for the CDC 3600 computer. (JWR)

23044 (BNL-18056) KAON–NUCLEUS INTERACTION. Dover, C. B. (Brookhaven National Lab., Upton, N. Y.). 1973. 34p. (CONF-730722–1). Dep. NTIS $3.75.

From conference on nuclear and hypernuclear physics with kaon beams; Upton, New York, USA (2 Jul 1973).

A review is given of the reactions of K^+, K^-, and K_2^0 with nuclei. Qualitative features of the experimental and theoretical results and theoretical difficulties and ambiguities involved in obtaining a reliable kaon–nucleus potential are emphasized. (JFP)

23045 (CEA-N-1600, pp 114-116) CONSIDERATIONS ON THE EFFECTIVE NUCLEON–NUCLEON POTENTIAL TO BE USED IN MICROSCOPIC DWBA CALCULATIONS. Escudie, J. L.; Terrien, Y. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

An effective two-body interaction for microscopic DWBA is derived. This includes spin–orbit and tensor forces. The shape is the sum of three Yukawa form factors. The calculation begins with the Hamada–Johnston potential and follows the Kuo–Brown procedure, utilizing the Scott–Moszkowski separation method to approximate the G-matrix. The fit is performed on the Fourier transforms of the potentials. (auth)

23046 (CEA-N-1600, pp 220-221) OPTICAL-MODEL CALCULATIONS. Cauvin, B.; Delaroche, J. P. 1972. (In French).

In nuclear physics department annual progress report, October 15, 1971–September 30, 1972.

Optical model calculations were made in order to fit the s-wave and p-wave strength functions. The magnitudes of the spin–spin term and the isospin term were investigated for several nuclei. (auth)

23047 (CONF-730312-(P1)) SYMPOSIUM ON HEAVY-ION TRANSFER REACTIONS: ARGONNE, ILLINOIS, MARCH 15-17, 1973. VOLUME I. Invited papers. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 411p. Dep. NTIS $22.75.

Separate abstracts were prepared for 11 papers in this volume. (LTW)

For abstracts of individual papers see: 22787 and 23048–23057.

23048 (CONF-730312-(P1), pp 1-8) SEMICLASSICAL TRANSFER THEORY. Winther, A. (Univ. of Copenhagen). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

The state of the art of the treatment of heavy-ion reactions by semiclassical methods is summarized. (LTW)

23049 (CONF-730312-(P1), pp 9-57) COULOMB-DOMINATED TRANSFER. Koerner, H. J. (Technische Univ., Munich). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

The data and analysis of heavy-ion-induced transfer on targets with $A \geq 40$, mainly those obtained with oxygen beams at energies of ~3 to 4 MeV/nucleon, are reviewed. One- and 2-nucleon and alpha transfer reactions are discussed. The features of broad, unresolved structure (bumps) in Coulomb-dominated transfer are described. (19 figures, 64 references) (LTW)

23050 (CONF-730312-(P1), pp 59-96) TRANSFER REACTIONS AT HIGH ENERGIES ON HEAVY TARGET NUCLEI. Kovar, D. G. (Univ. of California, Berkeley). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

The characterization of transfer reactions on heavy nuclei at high energies is discussed. Most of the experimental data comes from the Pb region where a variety of projectiles at a number of bombarding energies have been used. The status of the present theoretical analysis of the reaction data is described, particularly in regard to obtaining reliable spectroscopic information. Interpretation of the experimental results is presented from a DWBA point of view, and the discussion of the results of DWBA analysis is confined to the data of single-nucleon transfers. (17 figures, 27 references) (LTW)

23051 (CONF-730312-(P1), pp 97-144) HEAVY ION TRANSFER REACTIONS ON LIGHT NUCLEI AT HIGH ENERGY. Scott, D. K. (Nuclear Physics Lab., Oxford). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

Transfer reactions on nuclei below mass 50, induced by heavy ions of 5 to 10 MeV/nucleon where sufficient energy resolution exists to separate final states (typically 300 keV), are surveyed. The survey is based primarily on data from the cyclotron laboratories with reference to data at lower energies (~3 MeV/nucleon) from tandem accelerators. (20 figures, 88 references) (LTW)

23052 (CONF-730312-(P1), pp 161-174). DIRECT REACTION CALCULATIONS. Charlton, L. A. (Florida State Univ., Tallahassee). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

The MERCURY code is described which performs a general finite-range calculation for any direct process that may be treated as a cluster transfer. Mercury calculates the distorted-waves describing the free-particle relative motion for the initial and final states. It also solves for the bound-state wave function between the transferred duster and the residual nucleus. (LTW)

23053 (CONF-730312-(P1), pp 175-188) RECOIL EFFECTS IN HEAVY ION TRANSFER REACTIONS. Nagarajan, M. A. (Univ. of California, Berkeley). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

An approximate method of estimating the recoil corrections to the transfer amplitude in the reaction $(C_1 + N) + C_2 \rightarrow C_1 + (C_2 + N)$ is discussed, where N is the nucleon transferred. (LTW)

23054 (CONF-730312-(P1), pp 199-200) INELASTIC SCATTERING OF HEAVY IONS. Becchetti, F. D. (Univ. of California, Berkeley). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

Nuclear and Coulomb interference and the phase of the heavy ion–nucleus interaction are discussed. The shape of the heavy ion optical potential and determination of the deformation parameters are also dealt with. (LTW)

23055 (CONF-730312-(P1), pp 221-234) FORM FACTORS FOR TRANSFER REACTIONS. Kurath, D. (Argonne National Lab., IL). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

DWBA and the harmonic-oscillator model are used to consider in what way nuclear structure affects direct transfer processes in heavy-ion reactions. Nuclear structure effects in the particular case of α transfer are discussed. (LTW)

23056 (CONF-730312-(P1), pp 235-271) GENERATOR COORDINATE DESCRIPTION OF HEAVY-ION TRANSFER REACTIONS. Bonche, P. (CEN, Saclay, France). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

A method of calculating transition amplitudes for heavy ion transfer reactions is proposed that allows the use of the inert-core approximation. A transition amplitude is derived using shell-model wave functions. The generator coordinate method permits the exact treatment of the problems related to shell-model centers. The derivation of this transition amplitude involves approximations which are discussed for some particular cases. (LTW)

23057 (CONF-730312-(P1), pp 325-384) RESONANCES IN HEAVY ION REACTIONS. Stokstad, R. G. (Yale Univ., New Haven). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. I.

A survey is given of some of the experimental evidence for resonant phenomena which represent simple structure in the continuum. Their underlying nuclear structure is also discussed. (68 references) (LTW)

23058 (CONF-730312-(P2)) SYMPOSIUM ON HEAVY-ION TRANSFER REACTIONS, ARGONNE, ILLINOIS, MARCH 15-17, 1973. Volume II. Contributed Papers. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 320p. Dep. NTIS $18.00.

Separate abstracts were prepared for 29 papers in this volume. (LTW)

For abstracts of individual papers see: 22788–22792, 22838–22841, 22869–22873, 22892–22894, 22920–22922, and 23059–23067.

23059 (CONF-730312-(P2), pp 413-417) OPTIMUM Q VALUES FOR (^{16}O, C) REACTIONS BELOW THE COULOMB BARRIER. Anantaraman, N.; Katori, K.; Schiffer, J. P. (Argonne National Lab., IL). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

A classical method for estimating optimum Q-values in sub-Coulomb heavy-ion reactions is described, and such estimates are compared with experimental data on (^{16}O, ^{12}C) reactions from various targets (^{88}Sr, ^{124}Sm, ^{172}Yb). (LTW)

23060 (CONF-730312-(P2), pp 465-471) COMPETITION BETWEEN SIMULTANEOUS AND SUCCESSIVE TRANSFER PROCESSES IN TWO-NUCLEON REACTIONS AMONG HEAVY IONS. Broglia, R. A.; Gotz, U.; Ichimura, M.; Kammuri, T.; Winther, A. (Univ. of Copenhagen). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The competition between the simultaneous transfer a(≡ b + 2) + A → b + B(≡ A + 2) and the successive transfer a + A → {f(≡ b + 1) + F(≡ A + 1)} → b + B of two particles among heavy ions is studied in the framework of the semiclassical approximation. (LTW)

23061 (CONF-730312-(P2), pp 473-484) FORM FACTORS FOR ONE- AND TWO-NUCLEON TRANSFER REACTIONS AMONG HEAVY IONS. Broglia, R. A. (Univ. of Copenhagen); Kammuri, T.; Liotta, R.; Winther, A.; Nilsson, B. Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Methods for the calculation of finite-range form factors for transfer reactions between heavy ions are presented. Application is made to one- and two-nucleon transfer, where the form factors are used in DWBA calculations of a few reactions. (LTW)

23062 (CONF-730312-(P2), pp 509-511) PROGRAM FOR THE GENERATOR COORDINATE THEORY OF NUCLEAR REACTIONS. Giraud, B. (CEN, Saclay, France). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The generator-coordinate theory of nuclear reactions is briefly reviewed, and it is shown how a better understanding of nuclear reactions can be expected to emerge from the new theory. (LTW)

23063 (CONF-730312-(P2), pp 581-587) SHELL-EFFECT IN MULTI-NUCLEON TRANSFER REACTIONS INDUCED BY HEAVY IONS. Lemaire, M. C. (CEN, Saclay, France); Mermaz, M. C.; Sztark, H.; Cunsolo, A. Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

The shell effect in the Q and L dependence of the cross section in multi-nucleon transfer reactions induced by heavy ions is examined. The results of DWBA analyses of several reactions are shown. (LTW)

23064 (CONF-730312-(P2), pp 605-612) WAVE-MECHANICAL EFFECTS IN SEMI-CLASSICAL HEAVY-ION SCATTERING. Malfliet, R. A. (Univ. of Copenhagen). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

An extension of the semi-classical description of heavy ion reactions is proposed that makes it possible to give simple explanations of the oscillations in elastic and inelastic cross sections in terms of interference and rainbow effects arising from different classical orbits with the same deflection angle. There is agreement with quantum-mechanical calculations. (LTW)

23065 (CONF-730312-(P2), pp 637-645) ORIGIN OF J AND Q DEPENDENCE IN HEAVY-ION TRANSFER REACTIONS. Pougheon, F.; Roussel, P. (Institut de Physique Nucleaire, Orsay, France). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

It is shown that the J and Q dependence of heavy-ion transfer reactions can be deduced from a simple discussion of the physics of the problem. Angular momentum coupling schemes are also shown. (LTW)

23066 (CONF-730312-(P2), pp 675-679) COMMENTS ON WINDOW EFFECTS IN HEAVY-ION TRANSFER REACTIONS. von Oertzen, W. (Univ. of California, Berkeley). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Some observations on one-proton, two-proton, and α-particle transfer reactions are tentatively and simply explained as angle and Q-value windows. (LTW)

23067 (CONF-730312-(P2), pp 697-706) HIGH SPIN STATES FROM HEAVY-ION TRANSFER REACTIONS. Zamick, L.; Goode, P. (Rutgers—The State Univ., New Brunswick, NJ). Mar 1973.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

In symposium on heavy-ion transfer reactions. Vol. II.

Structure calculations of high spin states reached by heavy ion transfer reactions are reported. The reaction ^{40}Ca(^{16}O, 2p$\alpha\gamma$)^{50}Cr, performed at Munich, (tentatively) excites the 12^+ state of ^{50}Cr which decays as $(12^+) \rightarrow (11^+) \rightarrow 10^+ \rightarrow 8^+ \rightarrow 6^+ \rightarrow 4^+ \rightarrow 2^+ \rightarrow 0^+$. Calculations with the $f_{\frac{7}{2}}$ model are consistent with this assignment. The reaction ^{48}Ca(^{7}Li, 4n)^{51}V populates high spin states in ^{51}V. Only the calculation is discussed. To get states higher than $J = 15/2$, a neutron is excited from the $f_{\frac{7}{2}}$ shell to $p_{\frac{3}{2}}$, and the representation $[(p_{\frac{3}{2}} f_{\frac{7}{2}}^{-1})^{L_N}_{\nu} (f_{\frac{7}{2}}^{n})^{L_P}]^J \equiv [L_N L_P]J$ is used. This leads to many levels. The subsequent M1 decay routes are discussed. The calculations show evidence of semi-weak coupling. There should be many low frequency transitions with large values of B(M1) because states of given $[L_P L_N]$ with different J are such that the degeneracy is partly, but not completely, broken. The decay sequence of the YRAST levels is discussed; it is shown that these decays are not necessarily the strongest, and because of semi-weak coupling, other decays can easily be confused with them. (auth)

23068 (CONF-730823-9) POTENTIAL ENERGY SURFACES AND DEPENDENCE OF FISSION MASS ASYMMETRY ON THE INTERNAL EXCITATION ENERGY OF THE FISSIONING NUCLEUS. Schmitt, H. W.; Mustafa, M. G. (Oak Ridge National Lab., Tenn.; Vanderbilt Univ., Nashville, Tenn.; Oak Ridge National Lab., Tenn.). 1973. 11p. (SM-174/73). Dep. NTIS $3.00.

From third symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

A theoretical treatment of medium- and high-excitation fission was developed within the context of the shell-correction method of Strutinsky. The effective potential energy surfaces for ^{236}U at various excitation energies were calculated by extending earlier two-center-model calculations to include a distribution of occupation probabilities of the single-particle states obtained in the model. It is assumed that excitation of a compound, fissioning nucleus of any given shape gives rise to a distribution of occupation probabilities that may be represented by a Fermi function $F = [1 + e^{(\epsilon_i - \epsilon_F)/T}]^{-1}$, where ϵ_i, ϵ_F, and T are the energy of a single-particle level, the Fermi energy, and the nuclear temperature, respectively. For all shapes from the second saddle point to scission, the results of calculations to date show a decrease in deformation energy with increasing T for mass ratios near symmetry, and an increase in deformation energy with increasing T for asymmetric mass ratios. For ^{236}U, the absolute potential energy minimum shifts from asymmetry (140/96) to symmetry (118/118) at a nuclear temperature in the range 1.5 to 2 MeV, corresponding to an excitation energy of 60 to 100 MeV. The shell correction energy is found to approach zero asymptotically with increasing temperature; the specific form of this function depends on the nuclear shape. As a by-product of these potential-energy calculations, the relationship between excitation energy, E_x, and nuclear temperature, T, can be obtained for any of the deformed shapes encountered. It appears that the relationship is not very sensitive to shape, and may be represented approximately by $E_x \approx (A/9)T^2$. (3 figures) (auth)

23069 (COO-2171-21) NUCLEAR STRUCTURE THEORY. Annual Progress Report, October 1, 1972—September 30, 1973. French, J. B.; Koltun, D. S. (Rochester Univ., N. Y.). 1973. Contract AT(11-1)-2171. 9p. (UR-435). Dep. NTIS $3.00.

Progress during the last year in the following areas of nuclear structure and reaction theory is summarized: theory of energy level densities and spacings, with applications to a number of nuclear problems, including energy-level fluctuations as studied in slow-neutron spectroscopy; theory of locally averaged expectation values, with applications to orbit occupancies, the goodness of symmetries, and comparisons of effective Hamiltonians; theory of the effective interaction, including linear relations among nuclear energy levels and convergence of the reaction-matrix expansion; theory of hole energies measured in high-energy particle-removal experiments; nuclear reaction theory, including the optical model, heavy-ion transfer reactions above the Coulomb barrier, and partial width correlations; and meson interactions with nuclei, including muon capture reactions, pion scattering, and absorption. The report is descriptive in nature; several articles are being prepared for publication. (auth)

23070 (FRNC-TH-348) STUDY OF QUASI-ROTATIONAL STATES USING THE STRETCH SCHEME. Jaffrin, A. (Paris Univ., Orsay (France)). 1972. 230p. (In French). Dep. NTIS (U. S. Sales Only) $13.50.

Thesis.

The excited states of deformed nuclei appear, in general, in the form of quasi-rotational bands similar to a quantized rotator spectrum. Studies of the differences between the excitation energies and the structures of the wave functions in relation to this adiabatic limit were undertaken using the stretch scheme. This scheme has the advantage of explicitly containing the privileged proton–neutron coupling, which is the origin of the rotational behavior of the double open shell nuclei. Various applications of the stretch scheme enabled the low-excitation-energy 4p–4h and 2p–2h–2qp levels to be located in nuclei of the sd shell and the fp shell. The importance of 4-nucleon correlations established in this way is emphasized from the special characteristics of the spectra observed for α-transfer reactions induced by heavy ions. A detailed study of the validity of the adiabatic hypothesis which supposes the existence of a well-defined intrinsic state is undertaken for nuclei of the type core + alpha particle belonging to the sd and fp shells. (tr-auth)

23071 (FRNC-TH-379) NUCLEAR MUON CAPTURE AND SHORT-RANGE CORRELATION EFFECTS. Longuemare, C. (Paris Univ., Orsay (France)). 1972. 110p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

The Jastrow correlations and the F operator are introduced in order to account for short-range correlations in μ capture. A simple approximation is introduced to calculate the elements of the correlation matrix. The validity of this approximation is established by calculating the form factor for helium. The results are analogous to those obtained with a more complicated method. The elements of the μ capture matrix are expanded in terms of the correlations. The series obtained is of the same type as that derived from the Ursell–Mayer graph theory. Each term of the expansion is represented by a graph, and the amplitude of the transition obtained is expressed in the form of a sum on the contributions of the connected graphs. The rules for calculating the diagrams are defined; and those of the first order, presented. The partial capture yield and the first-order asymmetry are calculated in terms of the correlations in the Fermi model and the independent particle model, a Slater determinant with harmonic oscillator orbitals being used. The results obtained are exposed. Tne μ capture is calculated in the first order in terms of ^{4}He and ^{12}C correlations by using the delta approximation; the limiting asymmetry value of the most energetic neutrons is determined for the heavy nuclei, silicon and ^{40}Ca. (FR)

23072 (IAEA-279) NUCLEAR FISSION. Goldemberg, J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov. 1972. 11p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.00.

The basic ideas related to the progress of nuclear fission are outlined. The renewed interest in this field of research due to recent investigations relative to the fission of light nuclei is emphasized. (8 figures) (auth)

23073 (IFA-NR-42-1973) EXPLICIT EXPRESSIONS FOR THE INELASTIC SCATTERING CROSS SECTION IN THE STRONG ABSORPTION MODEL. Part 1. L = 0 to 5. Boca, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

Explicit expressions are derived in the strong-absorption model for inelastic scattering cross sections for values of the transition multipolarity between 0 and 5. Also, numerical tables for angular geometrical factors are given. (5 tables) (auth)

23074 (IFA-NR-43-1973) EXPLICIT EXPRESSIONS FOR THE INELASTIC SCATTERING CROSS SECTION IN THE STRONG ABSORPTION MODEL. Part 2. L = 6 to 9. Boca, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 39p. Dep. NTIS (U.S. Sales Only) $4.00.

Explicit expressions in strong absorption model for the inelastic scattering cross section with the multipolarity transition values between 6 and 9 are derived. Also numerical tables for angular geometrical factors are given. (auth)

23075 (IFA-NR-44-1973) EXPLICIT EXPRESSIONS FOR THE INELASTIC SCATTERING CROSS SECTION IN THE STRONG ABSORPTION MODEL. Part 3. L = 10 to 12. Boca, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 44p. Dep. NTIS (U.S. Sales Only) $4.25.

Explicit expressions in the strong absorbtion model for the inelastic scattering cross section with the multipolarity transition values between 10 and 12 are derived. Also numerical tables for the angular geometrical factors are given. (auth)

23076 (IFA-NR-45-1973) EXPLICIT EXPRESSIONS FOR THE INELASTIC SCATTERING CROSS SECTION IN THE STRONG ABSORPTION MODEL. Part 4. L = 13 and 14. Boca, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

Explicit expressions in the strong absorption model for the inelastic scattering cross section with the multipolarity transition values 13 and 14 are derived. Also numerical tables for the angular geometrical factors are given. (auth)

23077 (LA-UR-73-999) MODIFIED DEFINITION OF THE SURFACE ENERGY IN THE LIQUID-DROP FORMULA. Krappe, H. J.; Nix, J. R. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 25p. (CONF-730823-6; SM-174/12). Dep. NTIS $3.25.

From third symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

When calculated in the liquid-drop model, the deformation energy of strongly necked-in fission or fusion configurations shows a spuriously strong dependence on the details of the shape in the neck region. This is a consequence of the assumed sharp surface in the liquid-drop model. This model can be improved by replacing the surface-energy term by the self-energy of a drop caused by a short-range two-particle interaction. For a Yukawa function the self-energy integral can be evaluated analytically for a few important special configurations, and it can be transformed into a three-dimensional integral for arbitrary axially symmetric shapes. A numerical calculation is therefore only slightly more complicated than the usual treatment of the Coulomb energy. In addition to the parameters in the conventional liquid-drop model, the new definition of the nuclear part of the deformation energy contains a parameter to specify the range of the Yukawa function. Parameters for the new definition are determined from fission-barrier heights and interaction-barrier heights throughout the periodic table. The influence of the proposed change in the liquid-drop formula on the stiffness of spherical nuclei, the ground-state deformation, and the existence of shape-isomeric states in light nuclei is discussed. Fission-barrier heights and saddle-point shapes are determined for nuclei along the line of beta stability, and the static interaction potential between heavy ions is calculated. (9 figures) (auth)

23078 (LBL-1666, pp 28-31) EVAPORATION OF COMPLEX FRAGMENTS: KINETIC ENERGY AND ANGULAR DISTRIBUTIONS. Moretto, L. G. May 1973.

In nuclear chemistry annual report, 1972.

23079 (LBL-1666, pp 119-121) REACTION MODEL FOR THE $(\alpha,2\alpha)$ REACTION. Sherman, J. D.; Hendrie, D. L.; Giorni, A. May 1973.

In nuclear chemistry annual report, 1972.

23080 (LBL-1666, pp 140-142) NUCLEAR SKIN THICKNESS TREATED AS A STRUTINSKY VARIABLE. von Groote, H. H.; Myers, W. D.; Moeller, P.; Nilsson, S. G.; Nix, J. R.; Randrup, J.; Swiatecki, W. J.; Tsang, C. F. May 1973.

In nuclear chemistry annual report, 1972.

23081 (LBL-1666, pp 149-153) EFFECT OF ANGULAR MOMENTUM ON THE SHELL STRUCTURE AND PAIRING CORRELATION OF EXCITED NUCLEI. Moretto, L. G.; Clements, T. May 1973.

In nuclear chemistry annual report, 1972.

23082 (LBL-1666, pp 167-168) MICROSCOPIC CALCULATIONS OF THE VARIABLE MOMENT-OF-INERTIA MODEL. Ma, C. W.; Tsang, C. F. May 1973.

In nuclear chemistry annual report, 1972.

23083 (LBL-1950) NEUTRON AND GAMMA EMISSION IN FISSION. Nifenecker, H.; Signarbieux, C.; Babinet, R.; Poitou, J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 135p. (CONF-730823-15; SM-174/207). Dep. NTIS $8.75.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

Some of the characteristics of neutron and gamma emission in fission are reviewed. Recent measurements of the average number of neutrons as a function of fragment masses m and total kinetic energy E_k show distinctive differences with previous ones. The reasons for these discrepancies are analyzed and it is shown that, at present, the use of large neutron detectors yields safer results than that of small neutron detectors. The energy necessary for the emission of one additional neutron is discussed and shown to be of the order of 8 MeV, in the case of the ^{252}Cf spontaneous fission. This includes the effect of the observed correlation between neutron multiplicity and total γ ray energy. This correlation cannot be explained on the basis of neutron binding energy variations alone and is interpreted as an effect of the spins of the fragments. The gross features of the γ ray emission by fission fragments (time, energy, angular distributions) are summarized. These features

appear to be in agreement with a statistical de-excitation of the fragments provided angular momentum effects are suitably taken into account. The variances of the excitation energies of the fission fragments as a function of m and E_k are obtained from the observation of neutron number distributions. Here again it is shown that, at present, the use of large neutron detectors is the safer technique. The knowledge of these variances allows an improved estimation of the difference between the total energy release in fission and the minimum potential energy of the scission configuration. This difference is found to be at most of the order of 7 MeV in ^{252}Cf spontaneous fission. One of the basic assumptions of the "fission band" model is strongly supported by the observation of 1.7 MeV difference in the total kinetic energy of fissions giving rise to odd Z-odd Z and even Z-even Z pairs of fragments. This model also accounts for many of the aspects of the neutron and γ emission in fission. (auth)

23084 (LYCEN-73-17) PIONIC FIELD AND RENORMALIZATION OF THE AXIAL COUPLING CONSTANT IN NUCLEI. Ericson, M.; Figureau, A.; Thevenet, C. (Lyon Univ. (France)). Apr 1973. 9p. Dep. NTIS (U.S. Sales Only) $3.00.

The renormalization of the axial coupling constant in nuclei is related by PCAC (partial conservation of axial current) theory to the exchange effects in the pion vertex in view of studying the physical origin of the renormalization for β decay transitions. Using an optical model for the pion source function, it is shown that in large nuclei the renormalization arises from short range correlations. The analogy between this problem and that of an electric dipole inside a dielectric medium is pointed out. (auth)

23085 (ORNL-4902(Vol.1), pp 7-9) CALCULATION OF HEAVY-ION INTERACTIONS. Bertini, H. W.; Gabriel, T. A.; Santoro, R. T.; Larson, N. M. Aug 1973.

In Neutron Physics Division annual progress report for period ending May 31, 1973.

23086 (ORNL-tr-2680) STATISTICAL THEORY OF THE DECAY OF FISSIONABLE COMPOUND NUCLEI IN HEAVY-ION REACTIONS. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. Translated from JINR-P7-6798. 10p. Dep. NTIS $3.00.

Fission-evaporation competition of deexcitation of the compound nuclei produced in heavy-ion reactions is considered on the basis of a statistical approach. Calculations are carried out by the Monte Carlo method. Excitation functions $^{A_1}Y(^{A_2}X,xn)^{A_1+A_2-x}Z$ and energy dependence of fission cross section, $\sigma_f(T)$, are analyzed. Relative (not normalized to the cross sections) values agree better with experimental than do absolute values. In every case a good agreement between theoretical and experimental data can be achieved by special fitting of parameters; however, it is rarely possible to find a qualitative objective with low variation of these parameters when passing from one case to another. Still, it may be stated that the agreement is better, as a rule, if the ratio of level density parameters for fissioning and evaporating nuclei, a_f/a_n, is greater than 1. Moreover, this ratio appears to be closer to unity for heavier nuclei. Calculated results are quite sensitive to the value of a_f/a_n. It is very hard to get satisfactory agreement between theory and experiment in the high-energy range for incident ions with $T \approx 10$ MeV/nucleon, which shows the necessity of taking into account some direct processes and the nonequilibrium decay of excited nuclei. (7 figures) (auth)

23087 (ORNL-tr-2681) FISSION AND DECAY OF EXCITED NUCLEI. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. 1972. Translated by M. Gerrard (Oak Ridge National Lab., TN), from JINR-P7-6741. 24p. Dep. NTIS $3.25.

The statistical theory of the decay of excited nuclei is considered, including the competition between particle emission and fission. Fission barriers are given by a phenomenological formula which is an analog of the well-known Cameron formula, and approximates well the experimental data on nuclei up to transuranic elements. The contribution of shell corrections and odd-even effects is discussed. The calculated ratios of evaporation and fission widths, Γ_n/Γ_f, agree with experimental values even in the region of nuclei with $Z > 90$. The Γ_n/Γ_f values depend weakly on excitation energy for nuclei with $Z \approx 90$, while in other regions this dependence proves rather strong. The last conclusion does not contradict known experimental data since in experiment one usually measures some effective value (Γ_n/Γ_f), which is only indirectly related to the real Γ_n/Γ_f values. It is shown that the calculated values of Γ_n/Γ_f also do not depend practically on excitation energy. The effects of angular momentum and uncertainty in the choice of level density parameter are discussed. (10 figures, 2 tables) (auth)

23088 (OULNS-73-5) TWO-NEUTRON TRANSFER REACTIONS ON RARE-EARTH NUCLEI AND NUCLEAR DEFORMATIONS. Takemasa, T.; Sakagami, M.; Sano, M. (Osaka Univ. (Japan). Lab. of Nuclear Studies). 1973. 50p. Dep. NTIS (U. S. Sales Only) $4.50.

The angular momentum projection method is applied to the description of (t,p) and (p,t) reactions on deformed nuclei. The difference between the deformation of a target nucleus and that of a residual nucleus is explicitly taken into account in the calculation of the spectroscopic amplitude. The (p,t) reaction cross sections associated with the 0^+, 2^+, and 4^+ members of the ground state rotational band are calculated in the distorted-wave Born approximation. The neutron-number dependence of the ground state cross section is in good agreement with the experimental results, only when the difference between deformations of the target and residual nuclei is taken into account. Neither the magnitudes of the cross sections nor the angular distributions for the 2^+ and 4^+ state transitions are theoretically well reproduced, even when the following effects are taken into account: (i) difference between deformations of the initial and final states, (ii) the $|\Delta N| = 2$ admixture in the Nilsson model, and (iii) the hexadecapole deformation. The validity of the adiabatic approximation in the description of the two-neutron transfer reaction in deformed nuclei was investigated by comparing the adiabatic results with the projected ones. The results indicate that the adiabatic approximation is fairly good in the analysis of the two-neutron transfer reaction. (auth)

23089 (UR-436) ANALYSIS OF DISTANT-NEIGHBOUR SPACING DISTRIBUTIONS FOR k-BODY INTERACTION ENSEMBLES. French, J. B. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 12. Contract AT(11-1)-2171. 1972p. (COO-2171-22). Dep. NTIS $3.00.

The widths of the distant-neighbor spacing distributions for the eigenvalues of k-body Hamiltonians acting in finite-dimensional m-particle spaces are considered. The relation between the spacing widths as calculated by using a single spacing unit for the entire ensemble and by using separate units for each matrix (which has been of consequence in studying whether energy-level fluctuations can yield information about many-body components in the interaction) is calculated explicitly. A related question about the validity of an elementary ergodic theorem is settled. (auth)

23090 PERTURBATION THEORY FOR PROJECTED STATES. Peierls, R. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A; 333: No. 1593, 157-170(1 May 1973).

For quantum systems with a symmetry it is often convenient to start from a simple soluble model lacking the symmetry, and restore the symmetry by projection. If this is done for all eigenstates of the model system, one obtains an overcomplete set of basis functions, which is not suitable for standard perturbation theory. A method is developed by which one can do perturbation theory in this situation. The method is illustrated by application to the problem of the center-of-mass motion of a nucleus, the symmetry being the translational and Galileo invariance. (auth)

23091 PARTICLE MOTION IN GUIDE POTENTIALS AND THE COLLECTIVE NUCLEAR MOTION. Noerenberg, W. (Max-Planck Institut fuer Kernphysik, Heidelberg). Z. Phys.; 260: No. 3, 165-178(1973).

The motion of a particle which is constrained by a guide potential to move on a curve is studied within the framework of the generator coordinate method (GCM). In the limit of narrow guide potentials a differential equation for the wave function of the constrained motion is obtained which differs from the corresponding Schroedinger equation by an additional potential. This additional potential is due to the embedding of the curve in the space and depends on the form of the guide potential and on the curvature of the curve. The coupling terms are given explicitly, and it is shown that an adiabatic limit exists. Since the GCM can equally well describe the collective motion of nuclei, some insight into the more complicated problem of collective motion is obtained from its analogies to the studied problem of constrained particle motion: The collective motion of a nucleus can be considered as the motion of a particle with variable mass along a curve in a guide potential which is given by the interaction potential between the nucleons. Approximations to the idealized GCM used here are discussed and the connection with the method of Born, Oppenheimer and Villars is indicated. (auth)

23092 SECOND MOMENT OF THE SINGLE-HOLE STRENGTH DISTRIBUTION. Dieperink, A. E. L. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Z. Phys.; 261: No. 2, 117-123 (1973).

The second moment of the strength distribution of single-hole states in finite nuclei is discussed. Theoretical estimates for the second moment of single-hole states near the top of the Fermi sea appear to be larger than experimental values that can be derived from data on knock-out reactions; this indicates that experimen-

tally a part of the single-hole strength has not been observed. (2 figures) (auth)

23093 DESCRIPTION OF OFF-SHELL RESONANCES BY R-MATRIX THEORY. Lipperheide, R.; Moehring, K. (Hahn Meitner Institut fuer Kernforschung, Berlin). Nucl. Phys.; A211: No. 1, 125-135(1973).

The R-matrix theory of nuclear reactions is extended off the energy shell. An isolated resonance in the off-shell reaction amplitude is described by a simple generalization of the Breit-Wigner formula. In going from on- to off-shell, a resonance generally changes its size and shape. In particular, when the single-particle widths are small, an on-shell resonance of arbitrary shape due to interference with the background, will always become symmetric off the energy shell. (auth)

23094 DECAY WIDTH AND FINAL STATE IN α-DECAY. Schlitter, J. (Ruhr Univ., Bochum, Ger.). Nucl. Phys.; A211: No. 1, 96-104(1973).

If the theory for the decay of a prepared state is formulated in a model-independent way it leads to an equation for the final state. This continuum state is extremely nonresonant and orthogonal to the bound initial state which is used as a prepared state. The decay width is given by the matrix element of the exact Hamiltonian between these two states. Under certain conditions it can be reduced to a matrix element of the residual interaction. From the properties of the final state which are numerically tested with an example in potential scattering, follows the justification for the cluster ansatz in α-decay. (auth)

23095 EXCLUSION PRINCIPLE EFFECTS IN PION-NUCLEUS SCATTERING IN THE REGION OF THE 3,3 RESONANCE. Eisenberg, J. M.; Weber, H. J. (Univ. of Virginia, Charlottesville). Phys. Lett., B; 45B: No. 2, 110-114(9 Jul 1973).

Chew-Low theory for pion scattering is examined for a nucleon immersed in a Fermi sea. All exclusion principle effects, including those internal to the pion-nucleon scattering amplitude, are considered, and the modifications of the 3,3 resonance in nuclei are studied. An optical model is constructed in a local density approximation. Results are compared with recent data on pion scattering from ^{12}C. (auth)

23096 TWO-NUCLEON TRANSFER AMPLITUDES IN THE GROUND-STATE ROTATIONAL BANDS OF EVEN NUCLEI. Yamamura, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 3, 1052-1054(Mar 1973).

As an approach from the side of the quadrupole force to make a bridge between quadrupole vibration and rotation on the basis of pairing plus quadrupole forces, the two-nucleon transfer is investigated in the case of quadrupole force only. The system of identical particles is considered in the single-j orbit with a quadrupole force. It is found that any two-nucleon transfer amplitude is much smaller than E2 transitions and moments, and one cannot expect that some particular multipoles enhance compared with the other ones in contrast to the case of multipole transitions and moments. (JFP)

23097 NOTE ON THE QUASI-GROUND BAND. Hasegawa, A.; Tanaka, H. (Saga Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 3, 1046-1047(Mar 1973).

Even-even nuclei are classified in the rotational-vibrational region. A simple schematic collective quadrupole potential energy at a fixed value of γ is used instead of the displaced harmonic potential, and it is investigated how the interval ratio for the levels will be influenced by the changes of the potential energy surface for β. (JFP)

23098 OVERLAP INTEGRAL IN DEUTERON EMISSION. Sabac, C.; Sandulescu, A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 6, 703-709(1973).

Sawaguri-Tobocman's expansion method is used to obtain an analytical expression of the width of the resonance levels in a reformulated resonance scattering theory and decaying phenomena for a compound nucleus ejecting a deuteron. (auth)

23099 STRUCTURE OF DECAYING NUCLEAR STATES. Dumitrescu, O. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 3, 277-292(1973).

Assuming as a model for the prepared state which is going to decay, a scattering state projected onto the bound states embedded in the continuum (BSEC) of a channel Hamiltonian $H_0 = H - H'$, the decay law is obtained. The exponential term still keeps its dominant nature as far as the widths are narrow. Correction terms, when this condition is not fulfilled, are obtained. The widths are expressed in terms of matrix elements $\langle c,\epsilon|V|\lambda(\epsilon)\rangle$ between channel states $|c,\epsilon\rangle$ and "compound" states $|\lambda(\epsilon)\rangle$. The effective interaction V includes both the modification of the full interaction difference H' caused by the truncation and the modification of the hard (soft) core nucleon-nucleon realistic potentials arising through a Brueckner-Bethe-Goldstone treatment. All the results of the previous decay theories (Thomas-Mang, Harada, Sandulescu, Kadmensky, etc.) are discussed as approximations of the theory. (auth)

23100 STATISTICAL MEASURE FOR THE REPULSION OF ENERGY LEVELS. Brody, T. A. (National Univ., Mexico City). Lett. Nuovo Cim.; 17: No. 12, 482-484(21 Jul 1973).

Wigner has surmised that in the Gaussian orthogonal ensemble the nearest-neighbor spacing should be distributed as $p(x) = \frac{1}{2}\pi x \exp(-\frac{1}{4}\pi x^2)$, where $x = S/D$ and S is the spacing between adjacent levels, D is the spectrum average of S, and p(x) is the probability density of x. The experimental data for many systems fit this rather well, and the predictions of the Gaussian orthogonal ensemble agree closely but not quite exactly. A new statistic for measuring the repulsion of energy levels is proposed by means of the ansatz $p_\omega(x) = Ax^\omega \exp(-\alpha x^u)$, where A, α, and u depend on ω, the parameter that measures the repulsion. The quantity ω may be determined by fitting discrete-level spectra. (1 table) (RWR)

23101 SUM RULES IN ELECTRON SCATTERING BY NUCLEI. Efros, V. D. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 8, 316-320(20 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 8, 442-445(20 Apr 1973).

New sum rules are formulated for the scattering of electrons by nuclei. Some of these sum rules are independent of the model in the single-particle approximation for the nuclear current. Such sum rules are attractive for an experimental determination of the contributions of the non-single-particle currents. (auth)

23102 DOORWAY STATES AND NUCLEAR-SPECTRUM STATISTICS. Brody, T. A. (National Univ. of Mexico, Mexico City); Mello, P. A.; Flores, J.; Bohigas, O. Lett. Nuovo Cim.; 7: No. 15, 707-712(11 Aug 1973).

A model is proposed for the statistical effects of intruding states such as doorway states of isobaric analog states. It is concluded that an intruding state will not affect spectrum statistics except in its neighborhood; for the level spacings the effect can only be seen by means of a fairly detailed analysis. (JFP)

23103 EFFECT OF SCREENING ON THE CRITICAL CHARGE OF A NUCLEUS. Marinov, M. S.; Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 9, 368-371(5 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 9, 511-514(5 May 1973).

The critical charge was calculated for a bare nucleus without allowance for the screening of the Coulomb field by the electron shell. The net result for the critical charge was a value of 171. (JFP)

23104 MICROSCOPIC THEORY OF ROTATIONAL MOTION IN DEFORMED ODD-MASS NUCLEI. I. Basic Ideas in Terms of an Illustrative Model. Matsuzaki, M.; Iwasaki, M.; Yamamura, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2252-2275(Dec 1972).

A full-quantum mechanical description of nuclear rotational motion in odd-mass systems is proposed from a microscopic viewpoint. The basic idea is the use of the sum-rule method which was recently developed by Gross, Nishiyama and Yamamara for the description of rotational motion in even-mass system. For simplicity, the discussion is restricted to the single-j shell model with a quadrupole interaction. It can be concluded that the rotational spectrum appears if E2-moments and -transitions satisfy the same relations as those predicted by Bohr's rotational model. At the same time, the different and the similar aspects between the structure of the rotational motions in the cases of even- and odd-mass systems are discussed. (auth)

23105 SHELL MODEL FORM FACTOR WITH EFFECTIVE INTERACTIONS. Ismail, M. (Cairo Univ.). J. Phys. (Paris); 34: No. 5, 369-372(May 1973).

The form factors for the inelastic scattering of nucleons by a target nucleus were studied using two different types of effective nucleon-nucleon interaction and the results were compared with those for the ordinary Gaussian potential. (FR)

23106 GROUPS OF DYNAMIC SYMMETRY IN NUCLEI. Afanas'ev, G. N.; Raichev, P. P. Fiz. Elem. Chastits At. Yadra; 3: No. 2, 436-461(1972). (In Russian)

The dynamical groups are studied in view of possible applications for describing of the levels and transition probabilities in nuclei. (auth)

23107 π-MESON ABSORPTION AND NUCLEAR STRUCTURE. Kopaleishvili, T. I. (Tilishi State Univ., USS26). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 439-480(1971). (In Russian).

The present status of the problem of pion absorption by nuclei is reviewed. The following main points are discussed: the absorption mechanism, the theoretical treatment of absorption processes and the problem of the application of these processes for studying nuclear structure. The pair absorption mechanism and related with it the two particle reactions ($\pi^{\pm}$, NN) is mainly considered which has been the subject of intensive experimental and theoretical investigations for the last ten years. (auth)

23108 SOME APPLICATIONS OF THE K-HARMONIC METHOD TO THE CALCULATION OF PROPERTIES OF ATOMIC NUCLEI. Baz, A. I.; Grin, Yu. T.; Demin, V. F.; Zhukov, M. V. (Inst. of Atomic Energy, Moscow). Fiz. Elem. Chastits At. Yadra; 3; No. 2, 275-317(1972). (In Russian).

The survey of calculations of the atomic nucleus properties with the K-harmonic method is given. For nuclei ^{3}H and ^{3}He the practical convergence of the K-harmonic series for the ground state wave function and energy is demonstrated. For heavier nuclei the binding energy calculations are performed only in the K_{min}-approximation. The results of calculations of the ground state properties (binding energy, quadrupole moment etc.) for the ground state of some nonspherical nuclei are presented. The K-harmonic method is compared with the Hartree–Fock method and the variation method of calculation in the oscillator basis. (auth)

23109 THEORY OF SHELL STRUCTURE OF NUCLEI. I. Kolomiets, V. M.; Konstantinov, B. D.; Strutinskii, V. M.; Khvorost'yanov, V. I. (Inst. of Nuclear Research, Kiev). Fiz. Elem. Chastits At. Yadra; 3: No. 2, 392-435(1972). (In Russian).

A shell correction model is formulated in order to describe oscillations of nuclear masses and other phenomena related to nucleon shells. In the theory, deviation of the actual nucleon distribution from statistically averaged one plays a role of a small parameter. Connection between the shell oscillations of nuclear masses and shell structure effects in the spatial density distribution of nucleons is discussed. (auth)

23110 DIRECT METHODS IN THE THEORY OF NUCLEAR REACTIONS. Zhigunov, V. P.; Zakhar'ev, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 499-526(1971). (In Russian)

Up-to-date methods of the nuclear reaction theory, which uses the channel strong coupling formalism, are reviewed. Different approaches of the theory are considered as concrete realization of unified principle by Bubnov–Galerkin–Petrov. The development of variational principles for scattering problem is discussed. (auth)

23111 FUNDAMENTAL STATES OF LIGHT EVEN–EVEN NUCLEI. Filippov, G. F. (Inst. of Theoretical Physics, Kiev). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 2, 315-341(1971). (In Russian).

The consideration is given to the possibility of theoretical description of the binding energies, radii, shape parameters and the region of stability of light even–even nuclei based upon the interaction potential whose parameters are consistent with the known experimental data on the two-nucleon system. (auth)

23112 RESONANCE ENERGIES OF NUCLEI. Schett, A. (CEN, Saclay, France). Lett. Nuovo Cim.; 7: No. 13, 584-586 (28 Jul 1973).

The nucleus is considered as a rigid body for the calculation of its eigenfrequencies. The resonance energies from the calculations are compared with experimental values from neutron reactions with ^{209}Bi, an almost spherical nucleus. Rather impressive agreement is obtained; however, general conclusions cannot be drawn from this particular example. (1 table) (RWR)

23113 TEMPERATURE DEPENDENT LINE SHAPE OF MOESSBAUER HYPERFINE SPECTRA IN THE PARAMAGNETIC AND THE ORDERED REGION. Schwegler, H. (Technische Hochschule, Darmstadt, Ger.). Fortschr. Phys.; 20: No. 4, 251-281(1972).

A general, microscopic and quantum mechanical theory of the temperature dependent line shape of Moessbauer hyperfine spectra is presented. This theory covers the slow as well as the fast relaxation region and spectra of both paramagnetic and magnetically ordered samples. On a phenomenological level the theory results in generalized Wickman equations but with explicit expressions for the relaxation parameters in terms of the interaction Hamiltonians. The connection between this fully quantum mechanical theory and the stochastic models is also discussed. Relaxation times are calculated for special interaction Hamiltonians. The relation between the relaxation times obtained by Moessbauer measurements and the results of other relaxation time measurements, especially those of the longitudinal susceptibility $\chi_{||}$, is also considered. The critical slowing down of the relaxation time above a transition point is briefly discussed. Finally the superparamagnetism hypothesis, which is able to explain the so-called anomalous spectra measured below transition points, is outlined. (auth)

23114 RESIDUAL TWO-BODY MATRIX ELEMENTS FOR PRE-EQUILIBRIUM CALCULATIONS. Kalbach-Cline, C. (Univ. of Rochester, NY). Nucl. Phys.; A210: No. 3, 590-604(1973).

The effective matrix elements which appear in pre-equilibrium calculations in the rate expressions for the residual two-body interactions have been evaluated from analyses of emitted particle energy spectra. Probably because of details in the model formulation, the results are found to depend on the nature of the projectile. They are, however, of reasonable magnitude and show a mass number and excitation energy dependence consistent with predictions based on calculations of mean free paths in nuclear matter. The square of the empirical effective matrix element is found to approximately obey the relation $M^2 = K_a A^{-3} E^{-1}$ with the values of K_a = 95 MeV^3 and 725 MeV^3 applying to proton and α-particle induced reactions respectively. The quantities A and E are the mass number and excitation energy of the system respectively. (auth)

23115 PROPERTIES OF NUCLEAR S-WAVE MATTER. Mueller, G. P. (Naval Research Lab., Washington, DC). Nucl. Phys.; A210: No. 3, 544-556(1973).

Comparative Brueckner and Jastrow studies of the properties of nuclear matter are somewhat hampered by the complexities of realistic nucleon-nucleon potentials. To avoid some of these difficulties a nuclear matter model called S-wave matter is investigated which consists of nucleons interacting via various of the Aviles S-wave delta function potentials. These potentials all fit the two-body S-wave scattering data for energies up to 500 MeV. By using Jastrow methods two-body contributions to the ground state energy ranging from 18 to 29 MeV are found, depending on the particular potential used; the results for a given potential are in good agreement with the Brueckner results of Haftel. In addition, there are significant Jastrow three-body contributions, indicating that the equivalent three-body Brueckner contributions should be evaluated. (auth)

23116 VALIDITY OF AN ALGEBRAIC-VARIATIONAL APPROACH TO THE THEORY OF COLLECTIVE MOTION FOR AN EXACTLY SOLUBLE SHELL MODEL WITH R(5) SYMMETRY. Dasso, C.; Krejs, F.; Klein, A.; Chattopadhyay, P. K. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., A210: No. 3, 429-442(1973).

An algebraic-variational approach to the theory of collective motion previously applied in variant forms to pairing and monopole interaction models is here developed for an exactly soluble shell model Hamiltonian with R(5) symmetry. The spectrum of this class of Hamiltonian operators has previously been shown to represent a two-dimensional vibrator-rotator. The approximation scheme developed yields almost exact results up to the two-phonon level in the spherical region and goes over smoothly into a theory of the lowest states of the ground state rotational band in the deformed regime. (auth)

23117 INTRINSIC STATE GENERATING THE GROUND STATE ROTATIONAL BAND OF A DEFORMED NUCLEUS AND ITS APPROXIMATE EQUIVALENCE TO AN ALGEBRAIC-VARIATIONAL TREATMENT: ILLUSTRATION BY AN EXACTLY SOLUBLE MODEL. Dasso, C.; Klein, A. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys.; A210: No. 3, 443-457(1973).

A class of intrinsic or trial states to generate the ground state band of a rotating nucleus in a highly schematized shell model possessing R(5) symmetry is constructed. The exponential form of the state links this work to a line of recent developments tracing back ultimately to the work of Jancovici and Schiff on the generator coordinate method. For the present case the state is a product of BCS states and is seen to contain more general (four-particle) correlations than a single deformed BCS state. A technique for the construction of the states is described. The major result is the proof that the cranking variational principle associated with the trial state is essentially equivalent (exactly equivalent in the thermodynamic or large system limit) to the algebraic-variational method described in the preceding paper, when the latter is restricted to the one-band approximation. The existence of sharp phase transitions in the model is then investigated analytically. A spherical to deformed transition is thus confirmed, as well as an anti-pairing transition. As explained, this is unrelated to the Coriolis anti-pairing phenomena. (auth)

23118 SEMI-EMPIRICAL ANALYSIS OF MAGNETIC MOMENTS OF SINGLE-PARTICLE (OR -HOLE) STATES AROUND

THE ^{208}Pb CORE. Nagamiya, S. (Tokyo Univ.). Phys. Lett.; 45B: No. 1, 15-18(25 Jun 1973).

Magnetic moments of single-particle (or -hole) states around the ^{208}Pb core were fitted by three state-independent parameters $\delta g_l^{(p)}$, $\delta g_l^{(n)}$ and α, where α is a parameter that is connected closely with δg_s and g_p. The analysis was performed under the assumptions that (i) the state-dependence of radial integral $I((nl)^2-(n'l')^2)$ involved in δg_s and g_p is calculated by the harmonic-oscillator potential, and (ii) δg_s is taken as being equal to $-4g_p$, as expected from the δ-force type core polarization. An excellent fit was obtained when $\delta g_l^{(p)} = 0.10(2)$, $\delta g_l^{(n)} = -0.05(1)$ and $\alpha = 1.2(1)$, which show that the main contributor to δg_s is the M1 core polarization and $\delta g_l^{(n)}$ is certainly smaller than 0. B(M1)'s for allowed transitions calculated with the use of the same parameters as above are smaller than the observed B(M1)'s whereas $\alpha = 1.01(1)$ explains well the observed B(M1)'s. (auth)

23119 PIONIC FIELD AND RENORMALIZATION OF THE AXIAL COUPLING CONSTANT IN NUCLEI. Ericson, M.; Figureau, A.; Thievenet, C. (Univ., Lyon). Phys. Lett.; 45B: No. 1, 19-22(25 Jun 1973).

The renormalization of the axial coupling constant in nuclei is related by PCAC to the exchange effects in the pionic vertex. Using an optical potential as a model for the pion source function, it is shown that in large nuclei the renormalization arises from the short range correlations. The analogy between this problem and that of an electric dipole inside a dielectric medium is pointed out. (auth)

23120 REACTION MECHANISM OF TWO-NUCLEON TRANSFER BETWEEN HEAVY IONS. Broglia, R. A.; Goetz, U.; Ichimura, M.; Kammuri, T.; Winther, A. (Univ. of Copenhagen). Phys. Lett.; 45B: No. 1, 23-26(25 Jun 1973).

The competition between simultaneous and successive transfer of two nucleons between heavy ions is studied in the semiclassical approximation. It is shown that second order effects often dominate the reaction. (auth)

23121 MUONUCLEAR ABSORPTION. Goulard, B. (Univ. of Montreal); Joseph, J. Phys. Lett.; 45B: No. 1, 27-29(25 Jun 1973).

It is pointed out that it is possible to make systematic use of the various methods and concepts set up in nuclear reaction theory in order to investigate muon absorption by a nucleus. An improved factorization method is given for illustration. (auth)

23122 JASTROW APPROACH TO NUCLEAR MATTER WITHOUT TRUNCATION OF THE CLUSTER EXPANSION. Grypeos, M. E. (Univ. of Thessaloniki, Greece). Phys. Lett.; 45: No. 1, 30-34(25 Jun 1973).

It is shown that an approximate expression in closed form can be obtained for the Jastrow trial energy per particle in nuclear matter. The undesirable truncation of the cluster expansion may thus be avoided. (auth)

23123 EFFECT OF THE CORE IN FORMATION OF REAL NUCLEI. Gorbatov, A. M. (Kalinin State Univ., USSR). Yadern. Fiz.; 17: No. 6, 1178-1190(Jun 1973). (In Russian).

A method taking into account soft or hard cores in the realistic NN interaction is proposed to calculate low-lying nuclear levels. It is shown that in spite of relatively small core radii the cores play an important role in the energy balance of a nucleus, and may be the main reason for saturation in real nuclei. (4 figures) (auth)

23124 METHOD OF CALCULATING THE CHARACTERISTICS OF EVEN–EVEN SPHERICAL NUCLEI. Troitskii, M. A.; Simonov, A. Ya. (Inst. of Atomic Energy, Moscow). Yadern. Fiz., 17: No. 6, 1168-1177(Jun 1973). (In Russian).

The theory of finite Fermi systems is applied to consider the properties of even–even spherical nuclei. The static moments of excited states and the transition amplitudes for nuclei with closed and unfilled shells are expressed in terms of constants of the finite Fermi system theory. The expressions presented are valid for those nuclei which have no collective level near the ground state. The magnetic dipole moments of the 2^+ states of magic nuclei are considered in the appendix. (5 figures) (auth)

23125 METHOD OF SMOOTHLY VARYING ANGULAR FUNCTIONS IN THE THREE-BODY PROBLEM. Beloozerov, N. N. (All-Union Inst. of Scientific and Technical Information, Moscow). Yadern. Fiz.; 17: No. 6, 1161-1167(Jun 1973). (In Russian).

The properties of the angular functions required to provide, in the external region, a rapid convergence of the three-body-system wave function decomposed in the above-mentioned angular functions are discussed. (1 figure) (auth)

23126 PARTICLE NUMBER PROJECTION STUDY WITH THE GENERATOR COORDINATE METHOD. Faessler, A.; Gruemmer, F.; Plastino, A. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 260: No. 4, 305-313(1973).

The generator coordinate method is used in order to describe pairing vibrations. The generating wave functions are particle-number-projected BCS wave functions. The method is tested in some simple models with the conventional pairing Hamiltonian and also applied to the even nickel isotopes. The results obtained can be regarded as encouraging. (2 figures, 3 tables) (auth)

23127 TERNARY FISSION IN THE LIQUID DROP MODEL. Diehl, H.; Greiner, W. (Univ., Frankfurt am Main). Phys. Lett., B; 45B: No. 1, 35-37(25 Jun 1973).

The fissioning of a nucleus into three equal fragments is considered in the liquid drop model. Saddlepoint energies for prolate and oblate ternary fission are given as a function of the fissility parameter. (auth)

23128 MATRIX ELEMENT FOR PENETRATION FACTOR IN M1 TRANSITIONS BETWEEN NILSSON STATES IN ODD-A NUCLEI. Krpic, D. K.; Anicin, I. V.; Vukanovic, R. B. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nucl. Data, Sect. A; 11: No. 7, 533-568(Jun 1973).

A matrix element needed for the calculation of the penetration parameter, λ, the ratio of the reduced nuclear penetration matrix element to the reduced matrix element for gamma emission, is presented. Values are given for M1 transitions between all pairs of Nilsson states with $\Delta N = 0$ and $\Delta K = 0,1$ for all shells and seven nuclear deformations. Other quantities needed for the calculation of λ have been tabulated by Browne and Femenia. (1 table) (auth)

23129 SYMPOSIUM ON THE NUCLEAR THREE BODY PROBLEM AND RELATED TOPICS, BUDAPEST, HUNGARY, JULY 8–10, 1971. Acta Phys. Acad. Sci. Hung.; 33: No. 2, 103-272(1973). (CONF-710708-).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971).

The conference included nine papers. Separate abstracts were prepared for all papers. (JFP)

For abstracts of individual papers see: 22645–22647, 22680, 22771–22773, 23130, and 23131.

23130 THREE-NUCLEON CALCULATIONS WITH LOCAL POTENTIALS. Sandhas, W. (Univ., Mainz). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 109-127(1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

The integral equations approach to the three-nucleon problem is reviewed. The results of different calculations with local potentials are compared. (auth)

23131 CRITICAL ANALYSIS OF MODELS APPLIED TO BREAKUP PROCESS. Slaus, I. (Univ. of California, Los Angeles). Acta Phys. Acad. Sci. Hung.; 33: No. 2, 191-232 (1973).

From symposium on the nuclear three body problem and related topics; Budapest, Hungary (7 Jul 1971). See CONF-710708-.

Experimental data demonstrate that the enhancement associated with the quasi free kinematic conditions in nuclear reactions is one of the most prominent features in a large energy interval. The experimental data on A(x,bx)B reactions were analyzed using various models: plane wave and distorted wave impulse approximations (PWIA and DWIA), modified simple impulse approximation (MSIA), several modifications of PWIA, higher order corrections in particular S-state final state interaction modifications of the PWIA, unitarized version of the truncated multiple scattering series, and the Amado model. (auth)

23132 INELASTIC ELECTRON SCATTERING IN THE GENERALIZED COLLECTIVE MODEL. Borie, E.; Drechsel, D.; Lezuo, K. (Univ., Mainz). Nucl. Phys., A; A211: No. 2, 393-404(1973).

The generalized collective model was applied to the description of electron scattering data for several nuclei. Three examples, namely ^{114}Cd, ^{64}Zn and ^{24}Mg are discussed explicitly. The theory is based on a quadrupole-type vibration of the nuclear surface which is governed by a collective Hamiltonian. The radial dependence of the nuclear surface has been assumed to be a two-parameter Fermi distribution. The model provides a reasonable description of both spectra and inelastic electron scattering. (auth)

23133 NUCLEAR OVERLAPS IN TWO-PARTICLE TRANSFER REACTIONS. Ibarra, R. H. (Univ. of Manchester, Eng.). Nucl. Phys., A; A211: No. 2, 317-322(1973).

A method for calculating the nuclear overlap that enters in two-particle transfer DWBA calculations is developed. It is shown that two-particle overlaps must yield correct one-particle transfer form factors if they are to be consistent with one another. This consistency requirement imposes an important test on prescrip-

tions now in use for calculating two-particle overlaps. It is found that the conventional well-depth prescription underestimates the magnitude of the overlap function in the surface region by as much as 43%. Applied to the $^{40}Ca(t,p)^{42}Ca$ reaction the use of the "realistic" overlap predicts a cross section which is about twice that using the well-depth prescription, in good agreement with experiment. (auth)

23134 NEUTRON TRANSFER TO UNBOUND STATES IN HEAVY-ION REACTIONS. Baur, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Trautmann, D. Nucl. Phys., A; A211: No. 2, 333-348(1973).

Using the post-interaction formalism of DWBA, a theoretical framework for the calculation of neutron transfer reactions to unbound states is given. It is formulated quite generally for heavy-ion reactions, while the (d,p) reaction is also treated as a special case. It is pointed out that the quantity of interest in such reactions is the neutron width, which may be extracted from such experiments in a model independent way. This is illustrated by the reaction $^{208}Pb(d,p)$ leading to an unbound state at 4.298 MeV excitation energy in ^{209}Pb. Special attention is also paid to interference effects with the break-up continuum which are generally present. For reactions below the Coulomb barrier, the integrals occurring in the theory can be conveniently calculated analytically. Thus a natural extension of the well-established treatment of neutron transfer reactions to bound states is given, which is well suited for numerical calculations and at the same time exhibits clearly the physically important features of transfer reactions to unbound states. (auth)

23135 SEMI-CLASSICAL DESCRIPTION OF HEAVY-ION REACTIONS. Dietrich, K.; Hara, K. (Technische Univ., Munich). Nucl. Phys., A; A211: No. 2, 349-371(1973).

Reactions between complex nuclei are formulated within the framework of the semi-classical treatment in such a way that the microscopic theory of nuclear structure can be easily incorporated. The non-orthogonality of the shell-model states is handled by the use of the dual basis. (auth)

23136 USE OF GENERATOR COORDINATES IN SCATTERING PROBLEMS. Gloeckle, W. (Ruhr Univ., Bochum, Ger.). Nucl. Phys.; A211: No. 2, 372-380(1973).

In the generator coordinate approach to scattering problems the use of both real and purely imaginary generator coordinates is proposed, in order to avoid the introduction of a singular weight function and the difficulties connected with its numerical treatment. (auth)

23137 MULTIPOLE EXPANSION METHOD FOR FINITE RANGE CALCULATIONS OF TWO-NUCLEON TRANSFER REACTIONS. Chant, N. S. (Univ. of Minnesota, Minneapolis). Nucl. Phys.; A211: No. 2, 269-288(1973).

A procedure for carrying out exact calculations of finite range effects in two-nucleon transfer reactions is described. The method utilizes an expansion of the transition amplitude as a function of the relative angular momentum of the transferred nucleon pair which is shown to converge very rapidly thus permitting calculations using comparatively little computer time. Finite range effects for the reaction $^{58}Ni(p,t)^{56}Ni$ at $E_p = 45$ MeV are shown to be much smaller than anticipated on the basis of first order local energy approximation estimates. (auth)

23138 INTERIOR OF THE NUCLEUS. Southworth, B. (CERN, Geneva). Energ. Nucl. (Paris); 15: No. 2, 126-128(Mar 1973). (In French).

A brief survey is presented on knowledge acquired about the nucleus since the work of Rutherford. A description is also given of the corresponding technical developments. (FR)

23139 THEORY OF PAIRING VIBRATION MODE. Ui, H.; Sagawa, H. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 49: No. 2, 491-506(Feb 1973).

A simple and exactly solvable model is proposed which exhibits all the characteristic features of the pairing vibration model of Bohr including the near-harmonic level sequences and the strong enhancements of the (L = 0) two-nucleon transfer reaction. This model consists of degenerate many-j single particle levels and degenerate hole levels with an energy-gap between them. The pairing interactions are taken into account, except for those between the particle and hole states. Using the empirical values of the single particle and hole energies together with the strength of the pairing interaction, the model is compared with the experimental data in Ni, Sn and Pb isotopes to get quantitative agreement. This model is further used as the basis states to diagonalize the more realistic case of the non-degenerate model with pairing interactions among all levels. It is found that the pairing vibration mode remains predominantly in the ground state of the non-degenerate model. (auth)

23140 CORE POLARIZATION EFFECTS ON FIRST-FORBIDDEN β TRANSITIONS AND THE ANALOGOUS El γ-TRANSITIONS. Ejiri, H. (Osaka Univ., Toyonaka, Japan). Nucl. Phys., A; A211: No. 2, 232-242(1973).

Effective coupling constants g^{eff} for the first-forbidden β-transitions with operators r and $\sigma \times r$ in medium and heavy nuclei were obtained by comparing experimental matrix elements with pairing model calculations. The matrix elements $\langle r \rangle$ were taken from the El γ-ray matrix elements for the isobaric analog states of the parent nuclei. The values g^{eff}/g are 0.2–0.3 for semi-magic nuclei and 0.4–0.5 for double-magic nuclei. They are analyzed in terms of isospin (spin) core polarizations. A simple expression for g^{eff} is given in a schematic model. The core polarizations explain well the obtained values of g^{eff}. Spin-flip matrix elements $\langle \downarrow \| t_- r Y_1 \| \uparrow \rangle$ were also analyzed. Detailed discussions are given on the possible giant resonances associated with the first-forbidden β-transitions. (auth)

23141 TWO-PARTICLE MATRIX ELEMENTS FOR USE IN NUCLEAR HARTREE–FOCK CALCULATIONS. Moharram, S. A. (Cairo Univ.); Hegab, M. K. H.; Wadia, W.; Batanouny, F. E. Atomkernenergie; 21: No. 3, 210-214(1973).

The two-particle matrix elements on a basis of harmonic oscillator wave functions are expressed and evaluated in terms of the one-particle matrix elements of the relative motion. The latter have been directly deduced by Elliot et al. from the nucleon–nucleon phase shifts. An appropriate method for storing and calling the two-particle matrix elements is also indicated. (3 figures, 3 tables) (auth)

23142 PION PHOTOPRODUCTION AND T > VERSUS T < ANALOG STATES IN N > Z NUCLEI. Nagl, A. (Catholic Univ. of America, Washington, DC); Ueberall, H. Phys. Lett.; 45B: No. 2, 99-102(9 Jul 1973).

The $T_>$ and $T_<$ components of giant resonance levels in H > Z nuclei cannot be unambiguously identified in photonuclear reactions. In charged pion photoproduction, their analogs may be so identified (at least for the spin-flip levels), as illustrated here with a ^{13}C target. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

23143 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 6, 1973. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 47p.

This listing includes 219 references. (MOW)

23144 TECHNOLOGY INDEX FOR PLASMA PHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 7, 1973. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 48p.

This listing includes 204 entries, with keywords or combinations of keywords indicating the content after each entry. (MOW)

23145 PLASMA PHYSICS INDEX. Volume 8, No. 7, 1973. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 195p.

This listing includes 506 references and keywords or combinations thereof that indicate the subject matter of the article. (MOW)

Confinement and Heating

23146 (IPP-1/131) SLAB MODELS FOR CLASSICAL DIFFUSION IN THE BELT PINCH. Bateman, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Mar 1973. 49p. Dep. NTIS (U.S. Sales Only) $4.50.

Classical diffusion is considered as a time-dependent and self-consistent problem for a free-boundary plasma in the plane slab and cylindrical slab geometries. These conditions approximate the Belt Pinch experiment. It is found that the instantaneous diffusion rate changes rapidly as the plasma spreads and the fields decay. There is a succession of at least four physical phenomena which can dominate under different conditions: The poloidal electric field decays rapidly during an initial, finite-β, transient stage. The pinch effect induced by the toroidal electric field may impede diffusion for an intermediate time span. After the pinch effects become negligible, Spitzer diffusion induces a pressure decay which is algebraic with time and a poloidal B-field decay which is exponential with time. Although the pressure decay is initially faster, the rates soon become comparable. The Pfirsch–Schlueter effect enhances this diffusion only late in the discharge after the plasma has spread out and the rotational transform has decayed. A formula is also found for the radial position of the cylindrical slab as the fields decay. For passive field programming, there is a fixed but unstable position. (GE)

23147 (ORNL-4896, pp 1-10) PLASMA THEORY AND COMPUTATION. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

The work reported here falls mainly into three distinct categories distinguished by the associated experimental program: (1) confinement and heating in Tokamak Devices, (2) high-beta equilibrium and stability, motivated primarily by the ELMO, Canted-Mirror, and ELMO Bumpy-Torus experiments, and (3) plasma formation and confinement in magnetic mirrors. Within each major category various questions have been addressed. (MOW)

23148 (ORNL-4896, pp 19-26) MIRROR CONFINEMENT. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

Experiments with electron-cyclotron-heated target plasmas in IMP have led to densities $n_e \lesssim 1 \times 10^{12}$ cm^{-3} and target quality $n_e/n_0 \lesssim 10$. The details of the measurements, using a neutral-beam diagnostic, are discussed. These values appear to be limited by loss processes caused principally by two mechanisms: (1) nonadiabatic confinement of energetic electrons and (2) mirror instability at low values of β caused by the anisotropic plasmas produced as a result of confinement in a well with closed surfaces of $|B|$. The proposed long-field experiment, a shallow-well magnetic-mirror configuration with open surfaces of $|B|$ which will avoid the difficulties encountered in IMP, is described. Experiments in INTEREM showing that high-β plasmas can be produced with well depths <1.5% are described. Additionally, lower off-resonance heating is shown to be as effective in suppressing microinstabilities as upper off-resonance heating, at least when the frequency is close to (but below) resonance at the minimum of the field. (auth)

23149 (ORNL-4896, pp 27-31) HIGH-BETA PLASMAS. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

Work on the ELMO Bumpy Torus (EBT) is progressing. It is anticipated that shakedown operation will begin in July. Spatially resolved measurements of cold- and hot-plasma end losses from the canted mirror were made. The measurements showed that the drift surfaces of the particles responsible for the cold end losses followed the midplane modulus B contour. No high-β effects were observed. However, energetic-electron end losses showed favorable high-β effects. The end losses moved away from the walls with increasing β. The canted mirror was dismantled last spring in order to begin construction of the EBT. (auth)

23150 (UCID-16335) PROGRESS TOWARDS MIRROR FUSION REACTORS. Post, R. F. (California Univ., Livermore. Lawrence Livermore Lab.). 25 Jul 1973. Contract W-7405-Eng-48. Dep. NTIS $3.00.

Two areas of recent progress are reviewed: (1) plasma confinement at high plasma density and (2) the development of intense highly focused neutral beams and their injection into plasmas in mirror machines. (MOW)

23151 TURBULENT HEATING OF IONS AND RELATED EFFICIENCIES IN A CURRENT CARRYING PLASMA. Piekaar, H. W. (Inst. for Plasma Physics, Jutphaas, India). Plasma Phys.; 15: No. 6, 565-575(Jun 1973).

The dependence of the ion temperature and the energy density on the strength of the applied electric field in a linear turbulent-heating experiment is reported. Time-resolved measurements of the hot ion density, the ion and electron temperature, and the heating efficiency are described. It is observed that for a hydrogen plasma density of 10^{20} m^{-3} and an applied electric field of 60 kV m^{-1} the bulk of the ions is heated to 1 keV within 1 μsec. (auth)

Diagnostics

Refer also to abstract 23164.

23152 (AD-744100) NONISOTHERMAL THEORY OF AN ELECTROSTATIC PROBE IN A WEAKLY IONIZED GAS. Jou, W. H. (Princeton Univ., N. J.). Apr 1972. Contract F33615-70-C-1244. 91p. (ARL-72-60). NTIS.

In the existing literature on the diffusion theory of the interaction between a weakly ionized plasma and a solid surface, the electron temperature is assumed to be constant. This assumption is dubious. For an absorbing probe immersed in a plasma, asymptotic theories based upon the small Debye length can be developed with electron energy balance taken into consideration. Detailed development is given here for both the cases when ions are much colder than electrons and when the temperatures of the two charged species are of the same order. The main results are as follows: (1) The current–voltage characteristics of the probe can be represented by an asymptotic series in which the leading term is the probe potential obtained under quasi-neutral approximation. (2) In general, the sheath scales are different from those obtained in isothermal theory and depend on the current (or probe potential) and the temperature ratio of the two charged species. (3) The cold ion approximation is valid only when the ion temperature is much lower than the electron temperature in both the quasi-neutral region and the sheath. (4) The ion current approaches the saturation value at a probe potential lower than that given by the isothermal theory. (auth)

23153 (BMFT-FBK-73-14) INTERFEROMETRIC MEASUREMENT OF THE THERMODYNAMIC STATE OF SHOCK-HEATED RARE GASES AND THE DETERMINATION OF THEIR CONTINUOUS EMISSION COEFFICIENTS. Weiss, C. O. (Technische Universitaet, Hanover (West Germany). Institut fuer Plasmaphysik). Jun 1973. 83p. (In German). Dep. NTIS (U.S. Sales Only) $6.25.

Electron and atom number densities of shock waves in Ar, Kr, and Xe were measured using a 2-wavelength laser Michelson interferometer. The typical error of $\int n_e \, dl$ is less than 1%. The measured electron densities agree with Rankine–Hugoniot calculations. In the equilibrium region, temperatures can be calculated from the densities to within an accuracy of 0.2%. Measurements of the continuum radiation at single wavelengths allowed the determination of ξ factors. (46 references, 12 figures) (auth)

23154 (ORNL-4896, pp 35-42) ATOMIC CROSS SECTIONS, PLASMA DIAGNOSTICS, AND THE CONTROLLED FUSION ATOMIC DATA CENTER. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

To increase the rate of data taking in determining T_i for the ORMAK plasma, the single-channel neutral spectrometer has been expanded to a seven-channel spectrometer. Interfacing with a PDP-8 computer permits an analysis of the ion temperature as a function of time during the discharge. Typical temperatures are 350 eV for a 120-kA discharge current and 18-kG toroidal field. Thermal detectors—thermopiles, pyroelectric crystals, and bolometers—have been evaluated and calibrated to measure the radiant energy escaping the ORMAK plasma. A liquid organic scintillator has been calibrated for the purpose of measuring neutron flux and energy spectra arising from D–D and D–T collisions in high-temperature plasmas. Developments are continuing on the application of Tl^+ and K^+ beam probes to toroidal plasmas. Calculations were completed on the beam trajectories for the ORMAK and ELMO Bumpy Torus plasmas. Measurements are proceeding to determine the electron capture and loss cross sections for Tl^+ and K^+ beams in H_2 and to determine the differential scattering cross section for the formation of D^- by D^+ impact in alkaline vapors. Cross sections were determined for the formation of D^- from the collisional dissociation of HD_2^+ in H_2. (auth)

23155 (UCID-16283) METASTABLE ATOM AND UV EXCITATION AS CORRECTIONS FOR SECONDARY-EMISSION-TYPE FAST-ATOM DETECTORS. Osher, J. E. (California Univ., Livermore. Lawrence Livermore Lab.). 14 Jun 1973. Contract W-7405-eng-48. 17p. NTIS $3.00.

The use of secondary emission type detectors for either warm He^+ plasma or any He-dominant background plasma would appear subject to major corrections from He* production. This problem is also present where Ne*, H*, or N* might be produced but as a much smaller correction. Toroidal plasma experiments would appear particularly vulnerable to this problem. Thus, any use of secondary emission type detectors should be carefully calibrated by independent means, with appropriate checks and corrections made for both metastable and uv production. (auth)

23156 RUNGE SOLUTION OF THE CONTINUUM EQUATIONS FOR SPHERICAL ELECTROSTATIC PLASMA PROBES. Dorman, F. H. (CSIRO, Port Melbourne, Australia). Aust. J. Phys.; 26: No. 2, 261-264(Apr 1973).

An approximate but convergent method is used to determine the electric potential and charged-particle density near non-small spherical probes in a weakly ionized continuum plasma. Quantities determined partly by experiment and partly from continuum theory are introduced into three continuum differential equations which are then solved using Runge's method. The initial conditions must be estimated iteratively until the sheath solution joins smoothly to the quasi-neutral solution. Two different types of solution curves are discussed. (auth)

23157 ACCURACY OF THE INTERFEROMETRIC METHOD OF PLASMA DIAGNOSTICS WHEN THE OPTICAL COMPONENTS BECOME HEATED. Rozantov, A. G. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 6, 648-649(Dec 1972).

Translated from Opt. Spektrosk. 33: No. 6, 1188-1189(Dec 1972).

The heating in the optical system gives rise to a systematic error in the measurements, since the refractive index of transparent materials depends on temperature. The phase shift due to the thermooptical characteristics of glasses is estimated, taking the case of a plane-parallel plate. This analysis is given. (MOW)

23158 LANGMUIR PROBE MEASUREMENT OF ELECTRON TEMPERATURE IN A DRUYVESTEYN ELECTRON PLASMA. Tan, W. P. S. (Univ. of Southampton, Eng.). J. Phys., D (London); 6: No. 10, 1206-1216(29 Jun 1973).

The interpretation of electrostatic probe characteristics to give the electron temperature in a plasma is taken a step further by considering the Druyvesteyn energy distribution for the electrons (Physica; 10: 69(1930) and Rev. Mod. Phys.; 12: 87-174(1940)). The electron-retarding current–voltage characteristic is derived for the Druyvesteyn case, and a procedure for determining the electron temperature is obtained. Experiments conducted in a plasma wind tunnel showed that the data agree better with the Druyvesteyn theory than with the Maxwellian theory for the pre-shock plasma region. (auth)

23159 TRANSVERSE CYLINDRICAL PROBE IN PLASMA DIAGNOSTICS. Tan, W. P. S. (Univ. of Southampton, Eng.). J. Phys., D (London); 6: No. 10, 1188-1205(29 Jun 1973).

A cylindrical Langmuir probe with its axis positioned transversely to the plasma flow is considered theoretically and experimentally. Together with results on electron temperature and density obtained from a complementary cylindrical probe placed parallel to the flow, the transverse probe is shown to be capable of yielding data on ion Mach number (and therefore flow velocity) at a point. Such a probe system is therefore useful in determining the structures of plasma shocks. Two theories were considered for the transverse cylinder: (a) when the ions are collected via an absorption surface surrounding the cylinder; and (b) when the ions are collected by the orbit-limited motion mode. Theoretical comparisons with experimental data were made on the basis of the ratio of the ion current collected by the transverse cylinder to the ion current collected by a parallel cylinder of the same radius and surface area, as a function of the ion Mach number. For the first theory it is shown that agreement with experimental data is better than with previous theories. (auth)

23160 SPATIALLY INHOMOGENEOUS FILTERS FOR THE ULTRASOFT X-RAY REGION. Peskov, V. D.; Sakharov, Ya. A.; Tishchenko, E. A. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 4, 140-142(20 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 197-201(20 Feb 1973).

To separate the 50- to 2000-Å radiation region it is proposed to use filters of uneven thickness obtained by sputtering aluminum on a collodion substrate. The operating principle of such filters is analogous to that of the spatially inhomogeneous filters used in the far-infrared. (auth)

23161 VZAIMODEISTVIE MEDLENNYKH CHASTITS S VESHCHESTVOM I DIAGNOSTIKA PLAZMY. (Interaction of Slow Particles with Matter and Plasma Diagnostics). Gott, Yu. V.; Yavlinskii, Yu. N. Moscow; Atomizdat (1973). 129p.

Questions on the interaction of slow particles (with energy less than 50 keV) with solids are examined. The present status of the theoretical and experimental investigation of the energy loss and the mean free path of particles in matter is described. Questions on the charge exchange of protons and their scattering during passage through layers of matter are also examined. Experimental methods, used for similar kinds of investigations, are described. Procedures for obtaining very thin layers of the material investigated (without backing), used as targets, are described in detail. A special section is devoted to the use of the phenomena for the corpuscular diagnosis of laboratory and cosmic plasmas. (tr-auth)

Kinetics (General)

23162 (COO-2081-12) NONLINEAR PHENOMENA IN COLLISIONLESS PLASMAS. Progress Report, September 1, 1972-August 31, 1973. Aamodt, R. E.; Berger, R. L.; Hoffman, J. M.; Williams, E. A. (Colorado Univ., Boulder). 1973. Contract AT(11-1)-2081. 47p. Dep. NTIS $4.50.

The primary effort during this contracting period was directed at understanding basic nonlinear mechanisms of importance to the heating and containment of collisionless plasmas. Emphasis was placed on those processes most likely to be important in open-ended systems but, in addition, parametric-instability problems associated with the laser–pellet implosion technique were examined. Also, several linear phenomena of potential relevance to the fusion program were studied, and these had to do with problems associated with rf heating and the coupling of radiation and electron beams into dense plasmas. (auth)

23163 (COO-3086-19) NUMERICAL STUDIES OF SHOCK FOCUSING IN A COAXIAL ELECTROMAGNETIC SHOCK TUBE. Lui, H. C. (Columbia Univ., New York. Plasma Lab.). 1973. Contract AT(11-1)-3086. 157p. Dep. NTIS $10.00.

Thesis.

The generation of a strong transverse MHD shock wave in a coaxial electromagnetic shock tube is simulated numerically. Further plasma heating is achieved by shock reflection and focusing on the end wall. The details of the two-dimensional axisymmetric flow in the shock tube and the process of shock focusing and reflection from a curved end wall are studied. In general, the drive currents can be arbitrary functions of time, and the end wall can be of arbitrary shape. The scheme used is the fluid-in-cell method (FLIC), modified for compressible, time-dependent magnetohydrodynamic flows to include a magnetic field perpendicular to the flow directions. The governing equations are the two-dimensional axisymmetric, ideal, single fluid MHD equations coupled with Maxwell's equations. Finite differencing is carried out for cells of variable shapes to accommodate solid walls and free surfaces. On a moving vacuum-plasma interface, a mixed Lagrangian–Eulerian procedure is used. (MOW)

23164 (JUL-907-pp) INVESTIGATION OF PLASMA TURBULENCE IN A TRAVELING-WAVE ACCELERATOR BY LASER SCATTERING MEASUREMENTS. Finken, K. H. (Kernforschungsanlage, Juelich (West Germany)). Dec 1972. 102p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

In order to examine the influence of plasma turbulence on plasma acceleration, the interaction between a wave of high amplitude and a plasma in a pulsed operated traveling-wave experiment was investigated (wave frequency 1MHz; pulse duration 12 μs). Besides conventional techniques, the 90° laser light scattering is mainly used for the diagnostics. The outer alternating field creates a cylindrically symmetrical compression Alfvén wave in the magnetized plasma. By varying the magnetic field and the density, radial eigenmodes of this wave can be excited in which 80% of the outer-wave energy in the plasma is dissipated. A simplified MHD model is derived to describe the plasma state. From a comparison between measured values and results of the model calculation, it can be seen that a greater dissipation of energy occurs due to turbulent effects when the drift rate between electrons and ions, caused by electric currents, exceeds the ion resonance velocity threshold. By using a traveling-wave accelerator for space propulsion, the flowing electric currents in the plasma are kept so small that the conditions required to excite the turbulences are not fulfilled. (GE)

23165 (TRITA-EPP-72-10) ELECTROSTATIC SINGULARITY IN A PLASMA IN A MAGNETIC MIRROR FIELD. Persson, H. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 22 Apr 1972. 15p. Dep. NTIS (U.S. Sales Only) $3.00.

Stationary states of a collisionless plasma in a magnetic mirror field are considered. If the condition of quasi neutrality is used to determine the parallel electric field, singularities with infinite values may appear, both in a closed plasma, and in a plasma with a particle beam extending outside the region considered. Velocity distributions giving singularities may for instance be produced by a current flow along the magnetic field. A physical interpretation in terms of supersonic motion in the nozzle formed by the magnetic field is discussed. In an attempt to determine the conditions for shock formation in the flow of particles against the obstacle constituted by the converging magnetic field, a simplified model including particle beams is considered in a bounded region, assuming quasineutrality in the midplane; the detailed coupling to the surroundings is not studied. A general method for determining singularities is presented, and local Bohm-type conditions on the beam energy at a singularity are discussed. Solutions are found to be singularity-free when the beam is either subsonic throughout the entire region, or supersonic in the same region. Due to the inhomogeneity of the magnetic field, there are also intermediate solutions with singularities, where a transition from supersonic to subsonic motion is expected. (MOW)

23166 (TRITA-EPP-72-32) REVERSE DEFLECTION AND CONTRACTION OF A PLASMA BEAM ENTERING A CURVED MAGNETIC FIELD. Lindberg, L.; Kristoferson, L. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Dec 1972. 78p. Dep. NTIS (U. S. Sales Only) $6.00.

A plasma beam is injected along a longitudinal magnetic field into a region of curved magnetic field. Two unexpected phenomena are observed: the beam becomes deflected in the direction opposite to that in which the field is curved, and it contracts to a flat slab perpendicular to the $\overline{\nabla} \times \overline{B}$ direction. The plasma is produced by a conical theta-pinch gun and studied by means of electric-potential and field probes, floating electric double probes, magnetic probes, ion analyzer, and image converter camera. The plasma beam is collisionless and its behavior is, in principle, understood on the basis of gyro-center drift theory. A fraction of the transverse electric field $\overline{E} = -\overline{v} \times \overline{B}$, which is induced when the beam enters the curved magnetic field, is propagated upstream and causes the reverse deflection by $\overline{E} \times \overline{B}$ drift. The field is propagated by a backflow of energetic electrons on that side of the beam, which becomes negatively polarized. These electrons were directly measured and their energy determined. Electric field components parallel to the magnetic field seem to be important. The phenomenon is of a general character and can be expected to occur in a very wide range of densities. The lower density limit is set by the condition for self-polarization, $nm_i/\epsilon_o B^2 >> 1$ or, which is equivalent, $c^2/v_A^2 >> 1$, where c is the velocity of light, and v_A the Alfvén velocity. The upper limit is presumably set by the requirement $\omega_e \tau_e >> 1$. The phenomenon is likely to be of importance e.g., for injection of plasma into magnetic bottles and in space and solar physics. (auth)

23167 THEORY OF FILAMENTATION IN RELATIVISTIC ELECTRON BEAMS. Benford, G. (Univ. of California, Irvine). Plasma Phys.; 15: No. 6, 483-499(Jun 1973).

Electron beams can be unstable to transverse modes that form small pinch structures, as first pointed out by Weibel. Beams not totally self-pinched are liable to this instability, so current-neutralized regions near the beam head should display it. If the background response is nonresistive, filamentation is very rapid; if an axial magnetic field is present, interchange instability is competitive and the two may not be distinguishable. Beam motion is usually dominated by the resistive region, where $(\omega a/c)^2 \gg 1$, which is treated in detail. Using helical particle orbits in a uniform beam, the dispersion relation and growth rates in a number of differing cylindrical configurations are described. Because all particles have a common betatron frequency, a sharp particle resonance appears that may be broadened by energy spread in the beam. Applications to experiment and methods of stabilization are considered. (auth)

23168 ELECTRON DISTRIBUTION FUNCTION FOR IONIZED Cs VAPOR. Archambault, Y.; Bourdier, A. (Thomson-CSF, Domaine de Corbeville, France). Compt. Rend., Ser. A, B; 276: No. 22, 833-836(28 May 1973). (In French).

The electron distribution function for a positive column of Cs vapor was measured. The results are compared with predictions made using a statistical model. (FR)

23169 RECOMBINATION EMISSION OF AN ARGON PLASMA ABOVE THE CUTOFF FREQUENCY. Aleksandrov, V. Ya.; Gurevich, D. B.; Podmoshenskii, I. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 12-13(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 24-27(Jan 1973).

The dependence of the intensity of the recombination continuum on the frequency is measured in an argon arc plasma at atmospheric pressure. If one uses the theoretically calculated values of $\xi(\nu)$, the drop in continuum intensity above the cutoff frequency gives an electron temperature that exceeds the actual electron temperature in the arc plasma by a factor of 1.5. A $\xi(\nu)$ function is proposed which is based on experimental data and which can be used to determine the electron temperature from the drop of the continuous spectrum in an argon plasma. (auth)

23170 PRODUCTION OF MULTIPLY CHARGED XENON IONS. Apard, P.; Bliman, S.; Geller, R.; Jacquot, B.; Jacquot, C. (CEN, Grenoble, France). Phys. Lett.; 44A: No. 6, 432-434 (16 Jul 1973).

A multiply charged ion source based on ecr heating is described, and abundances for xenon ions up to Xe^{13+} are given. (auth)

23171 CHARACTERISTICS OF PLASMA COMPRESSION IN Z-PINCH DISCHARGE. Hashino, Y.; Suemitsu, H.; Fukuda, K. (Kyoto Univ.). Jap. J. Appl. Phys.; 11: No. 5, 710-717(May 1972).

The motion of current sheet in a linear z pinch is analyzed by Leontovich–Osovets' equation combined with the circuit equation, and two characteristic phenomena observed are successfully explained. According to the calculation for higher circuit inductance, the value ρ_{0M} of initial mass density of gas in the discharge tube, at which a maximum appears in the heavy-particle density at maximum compression time of plasma, is given by $\xi \rho_{0M}^{s} \simeq 0.85$ for any kind of gas, where ξ is a parameter determined by experimental conditions. This relation gives good agreement with the experimental results. Further, the abrupt voltage change at the discharge gap and corresponding kink in current, observed by Kurchatov near the maximum compression time, are explained in relation to the trajectory of the current sheet calculated with lower circuit inductance. (auth)

23172 INVESTIGATION OF THE EARLY STAGE OF ARGON PLASMA DECAY. Part I. Polyanskii, M. N.; Skrebov, V. N.; Shukhtin, A. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 14-16(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 28-32(Jan 1973).

Spectroscopic, interference, and probe methods were used to investigate transfer processes in the early stage of argon plasma decay. It is shown that in the early stage of the decay radial oscillations of the charged particle density arise; in the presence of a constant electric field these lead to oscillation of the electron temperature. The existence of T_e oscillations can be established by spectroscopic methods. The period of the T_e oscillations is a factor of 2 less than the period of the n_e oscillations. A model to explain this experimental fact is proposed. (auth)

23173 CYCLOTRONIC RESONANCE IN WEAKLY IONIZED HYDROGEN PLASMA WITH NITROGEN, OXYGEN, AND AIR IMPURITIES. Mel'nik, V. M.; Lavrenko, V. O. (Inst. of Problems in Materials Science, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 6, 536-540(Jun 1973). (In Ukrainian).

Dependences were determined for a relative concentration of charged particles in weakly ionized low-temperature plasma obtained by a high-frequency discharge in rarefied hydrogen on the composition and amount of impurities (nitrogen, oxygen, air). The electrons present in the reaction volume are induced by the cyclotron resonance method that was recorded with an esr spectrometer. (auth)

23174 POPULATION DENSITY AND LTE OF EXCITED ATOMS IN A POSITIVE-COLUMN PLASMA. 1. Calculation

on Hydrogen. Fujimoto, T.; Ogata, Y.; Sugiyama, I.; Tachibana, K.; Fukuda, K. (Kyoto Univ.). Jap. J. Appl. Phys.; 11: No. 5, 718-725(May 1972).

A collisional–radiative model is applied to hydrogen plasma in a positive column and it is shown that as electron density increases in plasma, population density of an excited level goes, in general, along coronal and quasi- and full-saturation phases and finally reaches lte. Atomic processes responsible for these phases are examined so that a criterion is presented for each transition between the successive phases. Further, it is proved that the validity condition for lte proposed by Griem corresponds to the transition from the coronal to the quasi-saturation phase in a positive-column plasma. (auth)

23175 NEKOTORYE VOPROSY ISSLEDOVANIYA GAZORAZRYADNOI PLAZMY I SOZDANIYA SIL'NYKH MAGNITNYKH POLEI. (Certain Questions Pertaining to Investigation of a Gas-Discharge Plasma and Creation of Powerful Magnetic Fields). Novitskin, V. G. (ed.). Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1970). 172p.

This collection compiles material on MHD generators and superconducting installations reported at the conference of the Institute of Electromechanics in May 1968. Three-phase plasmatrons, their operating characteristics, and the physical processes in curved chambers are examined. The results of the experimental and theoretical investigations of gas-discharge plasmas, the behavior of plasma conductor in the gas current, energy balance of gas-discharge plasmas, questions of the stability of the burning of the discharge, effect of transverse magnetic fields and gas current on the breakdown voltage, pre-electrode phenomena, and distribution of the current on the electrode were reported. The results of the investigation on conditions and characteristics of the contracting arc were given. In the second part of the collection, problems on the production of strong magnetic fields and the use of superconducting materials for the creation of strong magnetic fields were examined. A test on the design and production of superconducting magnets and cryostats was described. The results of calculations and designs of magnetic systems were also reported. (tr-auth)

23176 NEUTRON GENERATOR AXIALLY ASSISTED BY LASER. Shatas, R. A.; Meyer, H. C. III; Stettler, J. D.; Roberts, T. G. U. S. Patent 3,748,475. 24 Jul 1973. Filed date 17 Feb 1972. 4p.

A high-density pulsed plasma generator produces a high-temperature plasma sensed by a photo-switch which in turn triggers the operation of a high-energy pulse laser. The frequency of the laser light is such that the plasma will absorb it. The laser is disposed in coaxial alignment with the center electrode of the plasma gun so that the high-energy laser radiation illuminates the plasma blob axially to its motion with respect to the center electrode of the coaxial plasma gun. (Official Gazette)

Kinetics (Experimental)

23177 (TRITA-EPP-73-6) EXPERIMENTS ON THE VELOCITY DISTRIBUTION OF A ROTATING PLASMA. Bergstroem, J.; Hellsten, T. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 22 Dec 1973. 38p. Dep. NTIS (U.S. Sales Only) $4.00.

A fully ionized rotating hydrogen plasma with a density of the order of 10^{21} m^{-3} is generated by the crossed field technique. The following experimental results were obtained: (i) The velocity distribution of the plasma was calculated from data obtained by means of electric potential measurements at the end insulators of a rotating plasma device. (ii) The existence of the critical velocity phenomenon earlier postulated by Alfvén is confirmed. It is further proved that this phenomenon is localized to the partially ionized surface layers at the end insulators. (iii) Efforts were made to exceed the critical velocity limit by introducing a set of concentric metal rings at the end insulators. So far these measures have not been successful, but they have still provided new information about the critical velocity mechanism. (iv) There exist azimuthal spoke-shaped inhomogeneities in the surface layers of the end insulators, rotating at about the same velocity as the main plasma body. (auth)

23178 EXPERIMENTAL INVESTIGATION OF THE RELAXATION OF EXCITED STATES IN A DECAYING ALKALI PLASMA. Dudko, D. Ya.; Korchevoi, Yu. P.; Lukshenko, V. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 17-20(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 33-39(Jan 1973).

The characteristics of the relaxation process of excited P, S, D, and F states are investigated in decaying cesium and potassium discharge plasmas. The influence of reabsorption on line luminescence is considered. It is shown that the populations of levels associated with the continuum and of levels associated with the ground state exhibit different behavior during decay. There is an identical time variation in the concentration of excited atoms in states with equal energies. The difference in behavior during the afterglow of lines of various cesium series, observed in N. D. Morgulis et al. (Opt. Spectrosc., 30: 325(1971)), is ascribed to the influence of reabsorption. (auth)

Kinetics (Theoretical)

23179 (COO-2059-25) NUMERICAL INTEGRATION OF THE VLASOV EQUATION. Shoucri, M.; Knorr, G. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Jul 1973. Contract AT(11-1)-2059. 21p. Dep. NTIS $3.25.

A numerical method is described for the solution of the nonlinear Vlasov equation. The distribution function is expanded in a series of orthogonal polynomials, namely the Chebyshev polynomials. The conditions under which this expansion is valid are discussed. Recurrence effects are eliminated by formally adding a damping term to the eigenvalues of the truncated system. Nonlinear effects are simulated by an amount of information corresponding to less than 500 "particles". (auth)

23180 (FRNC-TH-382) THEORETICAL STUDY IN THE FRAMEWORK OF LINEAR AND QUASILINEAR APPROXIMATIONS OF THE VLASOV EQUATION OF LONGITUDINAL PLASMA OSCILLATIONS. Verification Using Numerical Experiments. Development of a Method Enabling Quantum Analogies to be Used. Braun, J. C. (Nancy Univ. (France)). 1971. 137p. (In French). Dep. NTIS (U.S. Sales Only) $9.00.

Thesis.

The linear theory of Landau for longitudinal plasma oscillations in the framework of the small oscillation approximation is recalled. Considerations are oriented essentially about the quasi-linear theory in which the expansions are considered up to the second order (Gary theory). These theories are generalized to the cases of electron oscillations in a non-Maxwellian plasma with a double beam electron distribution and ion oscillations in a Maxwellian plasma with an ion distribution function which varies in time and space. A numerical method is developed, which is linked with the decomposition of the distribution functions in a Fourier–Hermite space. The results obtained for electron waves in a Maxwellian plasma and in a double beam plasma are exposed. The effect of collisions and the case of ion waves are considered. A modified Wigner transformation is established which enables the wavefunction corresponding to a Maxwellian distribution function to be found. The correspondance between the Schroedinger equation and the Vlasov equation is demonstrated. The transformation is used to re-establish the results of linear theory. Extensions into the domain of nonlinear theory are envisaged. (FR)

23181 (IPP-IV-55) RELATIVISTIC THEORY OF ELECTROMAGNETIC SUSCEPTIBILITY AND ITS APPLICATION TO PLASMAS. O'Sullivan, R. A.; Derfler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Apr 1973. 47p. Dep. NTIS (U. S. Sales Only) $4.50.

Covariant constitutive relations are developed for an arbitrary, anisotropic, dispersive, dissipative medium, thus allowing for relaxation phenomena, and the covariant wave dispersion relation is derived. The susceptibility tensor of order four is given explicitly for a Vlasov plasma with arbitrary velocity distribution and nonzero dc. electric field. It is then shown how to determine the constitutive relation explicitly from the moment of the single-particle current, without using the Vlasov equation. The familiar "dielectric tensor" is obtained as a special case. (GE)

23182 (LRP-61-73) SIMULATION OF BELT PINCH EXPERIMENTS INCLUDING THE CIRCUIT EQUATIONS. Ignat, D. W.; Hofmann, F. (Ecole Polytechnique Federale de Lausanne (Switzerland)). Mar 1973. 24p. Dep. NTIS (U.S. Sales Only) $3.25.

An existing 1-D MHD code was modified to compute belt pinch experiments including the interaction between the plasma and the external circuit and self-consistent determination of the field in the toroidal core. Results of a computation simulating the Garching experiment are compared with those of a similar calculation which assumes a sine-wave time dependence for the current in the coil. Simulations of the belt pinch presently under construction at this laboratory were executed. Ion temperatures of ~200 eV with a 10-mtorr D_2 filling were computed. (auth)

23183 (UCID-16339) ELECTRON TRANSMISSION THROUGH A FULLY IONIZED GAS. Hirshfield, J. L. (California Univ., Livermore. Lawrence Livermore Lab.). 20 Aug 1973. Contract W-7405-eng-48. 19p. Dep. NTIS $3.00.

The Rosenbluth, MacDonald, and Judd form of the Fokker–

Planck collision term was applied to obtain approximate steady-state distribution functions for fast electrons penetrating a plasma. The plasma is represented in three model cases as: (a) made up of fixed positive and negative ions; (b) made up of fixed ions, and of cold electrons, but with electron thermal speed much less than test-particle speed. The formalism can also be extended to give analytic forms for the distribution function of ions as test particles, provided the test-particle speed is much less than the plasma electron thermal speed, and much greater than the plasma ion thermal speed. Aside from direct application to experiments on electron transmission through plasma, these solutions could have use in checking numerical solutions in various limiting cases. (auth)

23184 NUMERICAL SIMULATION OF GUIDING-CENTRE PLASMA. Christiansen, J. P.; Taylor, J. B. (Culham Lab., Abingdon, Eng.). Plasma Phys.; 15: No. 6, 585-597(Jun 1973).

A series of numerical experiments on a two-dimensional guiding-centre plasma of 3072 particles has been carried out and the results compared with theory. Correlation function shows general qualitative agreement with the theoretical predictions and the initial behavior is in good quantitative agreement. However, the limitations of the numerical experiments prevent accurate conclusions being drawn on the long-term behavior. Some suggestions for improvement are made. (auth)

23185 TRANSPORT EFFECTS IN A TURBULENT FLOWING PLASMA. The Moment Relations. Shkarofsky, I. P. (RCA Victor Co. Ltd., Montreal). Plasma Phys.; 15: No. 6, 599-609 (Jun 1973).

The Cartesian tensor expansion of Boltzmann equation is applied to its time-averaged expression in a turbulent plasma system with flow. The frame of reference used is the mass-averaged flow velocity, averaged over time. Various macroscopic quantities, including laminar and eddy parts, are defined upon integration over intrinsic velocity and the moment relations are derived and shown to agree with other works. (auth)

23186 INVERSE AMBIPOLAR POTENTIAL IN A MAGNETIC MIRROR CONFIGURATION. Kesner, J. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 15: No. 6, 577-584(Jun 1973).

The calculation of the axial variation of the ambipolar potential in a mirror machine is presented for an angular ion distribution such that the potential presents a dip at the mid-plane; cold ions can be trapped in the electrostatic well. The cold ion density is calculated. (auth)

23187 EXACT SOLUTIONS OF THE MHD EQUILIBRIUM EQUATION FOR A TOROIDAL PLASMA. Maschke, E. K. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 15: No. 6, 535-541(Jun 1973).

For the ideal MHD equilibrium equation of an axisymmetric toroidal plasma, a class of exact solutions is given, which is valid for arbitrary aspect ratio. As particular examples, a solution with a fixed toroidal boundary of rectangular cross section and a solution of the doublet type are described. (auth)

23188 HYDRODYNAMIC PLASMA MODEL FOR NONLINEAR CONDUCTIVITY. Golden, K. I. (Northeastern Univ., Boston). Lett. Nuovo Cim.; 7: No. 14, 676-678(4 Aug 1973).

An expression is derived for the wave-vector and frequency-dependent bilinear conductivity tensor starting from a hydrodynamic model for warm plasmas free of external magnetic fields. (MOW)

23189 SHIELDING OF A MOVING TEST CHARGE IN A TURBULENT PLASMA. Shukla, P. K.; Spatschek, K. H. (Ruhr Universitaet, Bochum, Ger.). Phys. Lett.; 44A: No. 6, 398-400 (16 Jul 1973).

The far-field potential of a moving test charge in a turbulent collisionless plasma is calculated. The results differ considerably from previous test charge theories in nonturbulent plasmas. (auth)

23190 CONSIDERATION ON THE "EQUILIBRIUM" ELECTRONS DISTRIBUTION FUNCTION FOR A HOMOGENEOUS, HIGH-FREQUENCY, FULLY IONIZED PLASMA. Lupu, G. (Univ., Cluj); Mustata, C. Rev. Roum. Phys.; 18: No. 3, 365-372(1973).

The "equilibrium" electrons distribution function for a homogeneous, high-frequency, fully ionized plasma is $f_{0+0}^{0+0} = K_{1,2} \cdot u^{(3A/3A+1)} \cdot \exp\{-[3/2(3A+1)] \cdot u^2\}$ which has as a limit, the global Maxwellian electrons distribution function. f_{0+0}^{0+0} is non-Maxwellian not only to some restrictive physical condition imposed on the plasma (and therefore on the integrated equations) but also to the truncation procedure of the system of equations. (auth)

23191 THEORY OF SPECTRAL LINE BROADENING BY ELECTRONS IN A NONEQUILIBRIUM PLASMA. Asmaryan, E. A.; Klimontovich, Yu. L. Opt. Spectrosc. (USSR) (Engl. Transl.); 34: No. 1, 111-112(Jan 1973).

Translated from Opt. Spektrosk.; 34: No. 1, 198(Jan 1973).

The line width of the $n \rightarrow m$ transition is calculated, taking into account all the possible transitions between the levels n and m. Accordingly, the line width is determined by the spectral function of the electric field fluctuation not only at the resonant frequency but also at all the frequencies of possible transitions from the n and m levels. (MOW)

23192 OCCUPIED HYDROGEN LEVELS IN A HOT PLASMA AND THE RELATIONSHIP BETWEEN RADIATION AND IONIZATION RATE. Abramov, V. A.; Kuznetsov, E. I.; Kogan, V. I. At. Energ. (USSR); 33: No. 3, 845(Oct 1972). (In Russian).

This paper was summarized as paper No. 616/6767 with full copy held by TIC.

The results of calculations are shown for the case where the occupied hydrogen levels have p = 2 to 5 and intensity ratios for the Balmer lines, H_α/H_β, in the 3 to 1500 eV temperature range. Calculations of the average number of ionizing events per quantum of the Balmer series are compared with earlier ones. (MOW)

23193 CONDUCTIVITY TENSOR OF A COLLISIONAL PLASMA IN A MAGNETIC FIELD. Midha, J. M.; Gupta, S. C. (Punjab Univ., Patiala, India). Nuovo Cim.; 16B: No. 2, 352-354(11 Aug 1973).

The expressions for the components of the conductivity tensor for a collisional plasma in a magnetic field are derived within the framework of Grad's moment method. (auth)

Production

Refer also to abstract 23998.

23194 (SLA-73-5534) PULSED FUSION OF PELLETS USING ELECTRON BEAMS OR LASERS. Beckner, E. H.; Clauser, M. J.; Freeman, J. R.; Gerardo, J. B.; Jones, E. D.; Toepfer, A. J.; Yonas, G. (Sandia Labs., Albuquerque, N. Mex.). 1973. 31p. (CONF-730705-13). Dep. NTIS $3.75.

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

The physical and technological concepts and barriers which are important for pulsed fusion of pellets using relativistic electron beams or lasers are discussed. Recent numerical calculations of pellet dynamics are described for the two cases in order to illustrate the similarities that exist and to indicate the significant differences which can be utilized in the spatial and temporal scale of the implosions. These calculations specify the experimental parameter regime that must be achieved, with input energy ranging as low as a few hundred kilojoules in the case of electron beams and a few kilojoules in the case of lasers; power densities in the two cases tend to be comparable. An assessment of current technology is then made for comparison. Finally, the remaining physical problems and the solutions required for achievement of fusion break-even experiments are discussed. (12 figures, 40 references) (auth)

23195 (SLA-73-5679) ELECTRON BEAM FOCUSING AND APPLICATION TO PULSED FUSION. Freeman, J. R. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 14p. (CONF-730826-1). Dep. NTIS $3.00.

From workshop on the non-linear interaction of lasers and electron beams with plasmas; Trieste, Italy (13 Aug 1973).

Ideas and suggested problem areas related to electron-beam pellet-heating experiments are reviewed. Efforts are underway to design a 3-MV, 3-MA, 10-nsec machine. The physics of focusing and deposition is briefly discussed. The accomplishment of beam focusing in low-impedance configurations to over 10^6 A/cm^2 in millimeter spot sizes is described. (MOW)

23196 TRANSIENT CHARACTERISTICS OF NANOSECOND BEAM GENERATED PLASMAS IN MAGNETIC FIELD. Takeda, S.; Tanaka, Y.; Yamamoto, T.; Kawanishi, M. (Osaka Univ., Suita, Japan). Mem. Inst. Sci. Ind. Res., Osaka Univ.; No. 30, 97-104 (Mar 1973).

The transient characteristics of nanosecond beam-generated plasmas in a magnetic field were studied. Injection of the electron beam pulse (100 keV, 1.0 A, 1 nsec to 2 μsec) into the neutral gas brought about the rapid production of dense plasma, and the transient buildup processes of plasma were observed. The buildup time is defined as the time between the injection of the electron beam and the initiation of the secondary ionization and was measured for various gas pressures. (auth)

23197 SOME FEATURES OF AN ELECTRON CYCLOTRON RESONANCE PLASMA PRODUCED BY MEANS OF A LISITANO COIL. Okamoto, Y.; Tamagawa, H. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 11: No. 5, 726-731(May 1972).

Characteristics of an ecr plasma produced by means of an L coil are studied in changing the location of the exact ecr condition on the coil. It can be seen that the energy distribution function for ions changes from double-humped to Maxwellian, and the quiescent plasma is obtained. Ion composition of the plasma is measured as a function of electron temperature, and the chemical reactions in the plasma are discussed. (auth)

23198 METHOD AND DEVICE FOR PRODUCING THERMONUCLEAR PLASMA. Kapitza, P. L. U. S. Patent 3,749,639. 31 Jul 1973. Priority date 22 Aug 1969, USSR. 8p.

The method for producing a thermonuclear plasma according to the present invention is characterized in that an electric discharge is created by high-frequency electromagnetic oscillations of such a mode and frequency that within the discharge zone there is provided a maximum concentration of the electric field, while a gaseous working medium is compressed and rotated about the horizontal axis of the electric discharge. The device for effecting the proposed method comprises a resonant cavity and a coupling element made so as to provide a maximum concentration of the electric field within the central portion of the resonant cavity and also comprises means for compression of the gaseous working medium inside the resonant cavity and for rotating it about the horizontal axis of the resonant cavity. (Official Gazette)

23199 LASER-INDUCED THERMONUCLEAR FUSION. Nuckolls, J.; Emmett, J.; Wood, L. (Lawrence Livermore Lab., CA). Phys. Today; 26: No. 8, 46-53(Aug 1973).

The prospects for controlled fusion using pulsed lasers are surveyed. The conditions for implosion and thermonuclear burn are reviewed. Laser technology, in particular, Nd, CO_2, CF_3I, and Xe laser developments are briefly discussed. The fusion fuel combustion chamber and energy conversion are also briefly described. (6 figures, 24 references) (MOW)

23200 INSTABILITIES AND LIGHT SCATTERING IN AN EXPANDING MULTICOMPONENT PLASMA. Rudakov, L. I. JETP Lett. (USSR)(Engl. Transl.); 17: No. 7, 273-275(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 382-385(5 Apr 1973).

When a plasma is produced by nanosecond laser pulses, a hot expanding corona is formed, in which the laser energy is absorbed. The possible causes for the darkening of the plasma corona are discussed. (MOW)

23201 RECENT DÉVELOPMENTS IN STRONG SHOCK WAVE RESEARCH. Gross, R. A. (Columbia Univ., New York). Contract AT(30-1)-3954. pp 91-99 of Dynamics of Ionized Gases. Lighthill, M. J. (ed). Tokyo; Univ. of Tokyo Press (1973).

From proceedings of the international symposium on dynamics of ionized gases; Tokyo, Japan (13 Sep 1971).

Recent progress in strong shock wave research is discussed. Shock speeds to 4×10^8 cm/sec and a plasma temperature of 10^{7}°K were achieved in an electromagnetically driven shock tube. The characteristics of this device and some of the physical data obtained from experiments are described. (auth)

23202 SHOCK WAVE PRODUCTION OF RELATIVISTIC PLASMAS. Taussig, R. (Columbia Univ., New York). Contract AT(30-1)-3954. pp 113-130 of Dynamics of Ionized Gases. Lighthill, M. J. (ed.). Tokyo; Univ. of Tokyo Press (1973).

From proceedings of the international symposium on dynamics of ionized gases; Tokyo, Japan (13 Sep 1971).

Recent shock wave experiments have created high temperature post-shock plasmas and shock speeds greater than 0.01 c. The feasibility and potential achievements of more energetic shock wave experiments are treated theoretically. Post-shock properties for steady, hydromagnetic relativistic shocks are presented. Scaling laws are derived which give the shock width, power, total energy, and magnetic fields needed to make relativistic post-shock plasmas. The thickness of fast shocks can be reduced by strong magnetic fields. Physical phenomena capable of revealing relativistic features in the plasma are discussed. (auth)

Stability

23203 (EUR-CEA-FC-676) LOCALIZED DISSIPATIVE DRIFT MODES IN TOKAMAKS. Adam, J. C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr 1973. 127p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Paris Univ., France.

An attempt was made to discover whether the anomalous diffusion observed in tokamaks could be explained in terms of a new microscopic instability dependent on known parameters. A localized model was constructed from the geodesic curvature of the lines of force in the tokamak geometry. The resolution of the Vlasov equation without any second term leads to an expression for the spatial structure along the force lines, the BKW radial approximation being applied. The growth rate is obtained by perturbing the quadratic form associated with the complete equation. It is possible to construct unstable convective modes having large radial extensions, even in the presence of extensive shearing of the lines of force. These modes have low growth rates, but in addition, low group velocities and can attain exponential factors in excess of 10 on the density gradient scale. The instability exists even in the absence of temperature gradients, such gradients serve to amplify the effect. All tori presenting moderate aspect ratios exhibit this instability even when the collision frequency is negligible due to resonant electron effects. It was established that the energy diffusion coefficient is highly anomalous as it is greater than the particle diffusion coefficient. (FR)

23204 (ITF-73-55-P) CRITERIA OF ABSOLUTE AND CONVECTIVE INSTABILITIES. Boiko, I. I.; Balev, O. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 35p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

Different criteria of wave growth, which allow the type of instability (absolute or convective) to be determined are compared. It is shown that the well-known criteria of Briggs and Feinberg–Kurilko–Shapiro (under certain specifications) are equivalent. One more way of defining the type of instability is suggested, based on investigation of the properties of branches of the multivalued function $\omega(k)$ in the complex k plane. A step-by-step procedure for definition of the type of instability in two-dimensional problems is pointed out. The whole process under consideration is restricted by the case of algebraic dispersion equations. (auth)

23205 (ORNL-4896, pp 11-18) ORMAK PROGRAM. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

The major goal of the present phase of the ORMAK program has been to see whether the advantages predicted theoretically for low aspect ratio, A (major radius to minor radius), and large bore are found in practice. An important advantage is the prediction that a critical parameter dependent on plasma temperature and machine configuration (the collisionality parameter) can be reduced significantly by low aspect ratio. A class of instabilities has been predicted to appear at small values of the collisionality parameter which might offset the other advantage of low aspect ratio, namely, plasma stored energy should scale as A^{-2}. This goal of demonstrating the usefulness of low aspect ratio has been achieved. No harmful effects of large toroidal curvature were found. The value of the collisionality parameter is small in absolute terms (i.e., less than 1) and smaller than in other operating devices, and no evidence of the appearance of a new class of instabilities was found. (auth)

23206 (ORNL-TM-4325) MICROINSTABILITIES IN INHOMOGENEOUS PLASMAS II: NUMERICAL RESULTS. Beasley, C. O. Jr.; Hicks, H. R.; Farr, W. M.; McCune, J. E. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 73p. Dep. NTIS $5.75.

Results are presented from studies of microinstabilities in a model mirror plasma. The model has a Gaussian density distribution of ions and electrons along a varying magnetic field, and a radial density gradient perpendicular to this field. Particles are contained self-consistently by a fictitious confining potential modeling mirror confinement. The ion velocity-space distribution is the finite-plasma equivalent of a Guest–Dory loss-cone distribution, and the electron distribution allows for finite temperature effects, including Landau damping. Resonant and nonresonant loss-cone instabilities are discussed. It is found that resonant instabilities are stabilized when the plasma length is less than a critical length which is dependent upon electron temperature, but modes corresponding to flute modes in homogeneous plasmas (Dory–Guest–Harris and drift-cone) are found to remain unstable at all plasma lengths. (auth)

23207 (UCRL-74947) NONLINEAR BEHAVIOR OF LIGHT-DRIVEN PLASMA INSTABILITIES. Kruer, W. L.; Estabrook, K. G.; Thomson, J. J. (California Univ., Livermore. Lawrence Livermore Lab.). 9 Aug 1973. 16p. Dep. NTIS $3.00.

A common feature of light-plasma coupling is the excitation of plasma instabilities by the intense laser light. The instabilities give rise to light absorption, reflection, and the production of energetic particles. The nonlinear behavior of many of these instabilities has been examined in computer simulations and theory.

A nonlinear theory is presented for the turbulent heating due to parametric instabilities near the critical density (where the laser frequency equals the electron plasma frequency). The linear instability is saturated by mode coupling of unstable electron plasma waves into Landau-damped ones, and the electrons are heated by velocity space diffusion in the plasma waves. The theoretical predictions are in good agreement with computer-simulation results. Computer simulations are also presented of laser-light backscattering in the underdense plasma outside the critical density due to the Raman and Brillouin instabilities. The light reflection is shown to decrease rapidly as the ratio of the light pressure to the plasma pressure is made small. Several techniques to suppress these reflective processes are demonstrated. Recent simulations of the 2 ω_{pe} decay instability and self-focusing are also discussed. (auth)

23208 EXPERIMENTAL STUDY OF TURBULENT PLASMA INSTABILITY. Adamov, I. Yu.; Berezhnyi, V. L.; Kononenko, V. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 6, 931-932(Jun 1973). (In Russian).

Some basic results are described of the θ-pinch plasma instability. Electromagnetic-wave scattering in the plasma is studied; oscillations with frequencies close to electron plasma frequency and wave numbers from 6 to 11 cm^{-1} were found. (auth)

23209 DYNAMIC STABILIZATION OF TOROIDAL PLASMA FILAMENT WITH CURRENT. Demirkhanov, R. A.; Kirov, A. G.; Zharikov, V. N.; Malykh, N. I.; Ruchko, L. F.; Zhdanov, V. A. JETP Lett. (USSR) (Engl. Transl.); 17: No. 8, 283-285(20 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 8, 397-400(20 Apr 1973).

It is shown that macroscopic stability of a current-carrying plasma filament in an $l = 3$ stellarator has a threshold-like dependence on the ratio $\eta = \tilde{p}/\bar{p}$ of the pressure of the high-frequency field to the pressure of the poloidal field, and that when $n \simeq 0.4$ is reached, the filament is stable at $q_{eff} \simeq 1$. In the stabilized regime $\tilde{\beta}_\phi \simeq \bar{\beta}_\phi \gg 1$. (auth)

23210 PARAMETRIC EXCITATION OF A PURELY GROWING INSTABILITY IN AN UNMAGNETIZED PLASMA. Lee, K. F. (Chinese Univ. of Hong Kong, Shatin). Phys. Lett.; 44A: No. 5, 345-346(2 Jul 1973).

It is shown that, in an unmagnetized plasma subject to an externally driven uniform electric field, a purely growing instability associated with perturbations perpendicular to the direction of the external electric field can be excited. (auth)

23211 THRESHOLD OF DECAY INSTABILITY IN AN INHOMOGENEOUS PLASMA. Piliya, A. D. (Physical-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 266-268(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 374-376(5 Apr 1973).

It is shown that, in a spatially inhomogeneous plasma, there can be no absolute stability of the decay type with an excitation threshold lower than that given by recent results (A. F. Andreev, Zh. Eksp. Theor. Fiz. 50: 1415 (1966)). Such an instability arises if both parametrically coupled waves have turning points inside the plasma layer. A brief analysis is described. (MOW)

Thermonuclear Engineering and Equipment

Refer also to abstracts 20864 and 23205.

23212 (ANL/CTR-73-1) A REPORT ON THE DEVELOPMENT OF INTENSE NEUTRON SOURCE FACILITIES FOR THE CTR TECHNOLOGY PROGRAM. Including a Summary of the Meeting on the Fusion-Neutron Source Development, AEC Germantown, December 5, 1972. Persiani, P. J. (Argonne National Lab., ILL). Aug 1973. Contract W-31-109-eng-48. 32p. Dep. NTIS $3.75.

Deuterium–tritium neutron facilities are classified in three groups: (1) accelerator and target systems, (2) dense plasma focus, supersonic gas–jet target, liquid–jet target (LiT), laser–plasma interaction, electron beam–plasma interaction, and drift-orbit cyclotron heating, and (3) linear theta-pinch, mirror machines, and others. Design related considerations are described for each. (MOW)

23213 (BNL-18062) SUGGESTIONS FOR FUTURE WORK ON HIGH-INTENSITY NEGATIVE HYDROGEN SOURCES. Prelec, K. (Brookhaven National Lab., Upton, N. Y.). 27 Jun 1973. 4p. Dep. NTIS $3.00.

A few suggestions are given on how to proceed in the development of a high-intensity negative hydrogen source. They include use of a neutral gas jet in the discharge, adaptation of the Ixion plasma device and development of a multi-aperture source. (auth)

23214 (IPP-2/211) SUPERCONDUCTING ENERGY STORAGE. Wipf, S. L. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 41p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Considering the fusion experiments in plasma physics, the realization possibilities of superconducting energy storage are investigated. Besides the optimization of the coil shape, the discharging process problems are dealt with. Thus it can be seen that losses during discharging are only hard to avoid if the advantages of high density energy or fast discharging are to be made use of. Furthermore, there is no suitable cryoresistive switch as well as conducting material for the storage coil whose alternating current losses are so small that the superconducting during discharging is maintained. (GE)

23215 (IPP-2/213) PROJECT WENDELSTEIN W VII. Wolf, G. H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Apr 1973. 44p. (In German). Dep. NTIS (U.S. Sales Only) $4.25.

The stellarator Wendelstein W VII is an apparatus being built at IPP for the production and long-term confinement of hot plasmas. Its dimensions and magnetic field strength, etc. have been chosen so as to investigate and satisfy the plasma physical conditions necessary to build a thermonuclear reactor. With these scientific aims, the following points are to be taken into account: broadening the experimental study of plasma confinement using stellarators in the operating ranges where the single plasma particles travel long distances (up to some hundreds of meters) before they considerably influence each other on their normal trajectory, which is mainly influenced by the magnetic field; broadening of the operating range to regions where neither the gas kinetic pressure of the plasma, nor the "pressure" of the confining magnetic field can be neglected; creation of plasma conditions typical for big Tokamaks; investigation of the influence and significance of various types of boundary conditions on the quality of the plasma confinement (energy and particle loss); and investigation of the heating processes exceeding Ohm's heating capacity as well as the investigation of methods for particle refilling. (GE)

23216 (LA-5323-MS) LASER PULSE SHAPING WITH NONLINEAR MATERIALS. Thorne, J. M.; Loree, T. R. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

The intensity-dependent light transmission of nonlinear optical materials can be used to tailor laser pulse shapes for CTR applications. Several interesting systems have been built and shown to be effective pulse shapers. Although pulse shapes matching any particular ideal shape for controlled thermonuclear reactions have not been demonstrated, the potential for producing such pulses is clearly evident. Calculations are presented to show how the optical parameters of the systems can be adjusted to give a wide variety of pulse shapes. These devices have response times in the picosecond range and can, in principle, be modified to operate in any part of the optical spectrum. (auth)

23217 (MATT-999) VERTICAL STABILITY OF TOKAMAK TYPE EQUILIBRIA AS A FUNCTION OF CROSS SECTIONAL SHAPE. Sheffield, G. V. (Princeton Univ., N. J. Plasma Physics Lab.). Aug 1973. Contract AT(11-1)-3073. 6p. Dep. NTIS $3.00.

The fact that tokamak-type devices with elongated cross section appear to have improved plasma parameters leads to the question of the stability of these configurations against vertical translation. This study investigates the vertical stability of both elliptical and rectangular cross section equilibria as a function of elongation. The stability analysis was done numerically through the use of a computer code. (auth)

23218 (ORNL-4896) THERMONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1972. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 58p. Dep. NTIS $5.45.

Separate abstracts were prepared for 7 of the included sections. (MOW)

For abstracts of individual sections see: 23147–23149, 23154, 23205, 23219, and 23220.

23219 (ORNL-4896, pp 43-47) ENGINEERING SCIENCES. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

The Engineering Sciences Group continued to provide support to the plasma physics programs of the Thermonuclear Division in the fields of superconductivity, magnet design, and cryogenics. A new program to investigate dielectrics at low temperature was initiated

as part of the nonnuclear program of the Division of Applied Technology of the AEC. A pair of nested superconducting coils was fabricated of Nb_3Sn and operated to 146 kG before failing due to internal arcing to ground. The coils have been redesigned and are being rebuilt. Investigations of fine-filament NbTi were begun. The water-cooled coils for the Bumpy Torus facility were designed and fabrication was initiated. Studies of higher-field coils for the ORMAK resulted in a further interest in the asymmetrical coils investigated briefly last year, this time as cryogenic coils. (auth)

23220 (ORNL-4896, pp 48-52) FUSION REACTOR TECHNOLOGY. Jul 1973.

In Thermonuclear Division annual progress report for period ending December 31, 1972.

During the past year the fusion reactor technology studies included the following areas of investigation: (1) the Blascon—an exploding-pellet fusion reactor, (2) materials compatibility studies, (3) magnetohydrodynamic effects in fusion reactor blankets, (4) neutronics, (5) radiation damage studies, (6) system studies, (7) tritium handling and recovery, and (8) alternate fuel cycles. (auth)

23221 (ORNL-TM-4336) TORUS WINDINGS WITH ASYMMETRIC MAGNET COILS. Gauster, W. F.; Walstrom, P. L. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

The idea of using asymmetric windings, which can be made relatively very thin at the inner side of the torus (toward the vertical torus axis), and of reducing the power demand by providing ample thickness toward the outside of the torus is investigated. Three different examples of asymmetric coil shapes are discussed: (a) eccentric circular coils, (b) circular coils with flat ends (which use more effectively the winding space without interfering with the inside space of the torus), and (c) coils with rectangular outside boundaries. It is possible to wind coils of Type (a) and (b) employing conductors of appropriate shape; however, also the Bitter-type design (helixes made up of plates) can be used. (MOW)

23222 (UCID-16308) THERMONUCLEAR REACTOR TEST FACILITY. Hooper, E. B. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 2 Jul 1973. Contract W-7405-Eng-48. 25p. Dep. NTIS $3.25.

A plasma, confined by minimum-B magnetic mirrors, is considered as a facility for studying the entire environment of a thermonuclear plasma. A parameter study including neutron flux calculations is presented. Neutron fluxes greater than $10^{14}/cm^2$-sec will be feasible in moderate size devices when neutral beam sustained thermonuclear plasmas are achieved. (auth)

23223 LITHIUM-COOLED TOROIDAL FUSION REACTOR. Mitchell, J. T. D.; Hancox, R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 1275-1283 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A design for a deuterium–tritium-fuelled fusion reactor incorporating plasma confinement in tokamak geometry is described, in which lithium simultaneously performs the functions of neutron moderation, tritium breeding and heat removal. The limitations of the system due to MHD losses in the circulating lithium are considered in the context of blanket design and materials properties. It is concluded that this inherently simple design could find application in both prototype and early commercial fusion reactors. (auth)

23224 DESIGN STUDY OF A PULSED HIGH-BETA FUSION REACTOR. Burnett, S. C.; Ellis, W. R.; Oliphant, T.; Ribe, F. L. (Los Alamos Scientific Lab., NM). pp 1284-1287 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A design study of a pulsed high-beta θ-pinch reactor is presented with emphasis on the physics considerations that govern the choice of reactor parameters. The reactor is designed to generate 1750 MWe with a duty factor chosen to limit the first-wall nuclear power loading to 3.5 MW/m^2. In addition to a description of the overall reactor system, particular emphasis is placed on the subject of plasma heating. The question of energy balance is discussed, and it is shown that the reactor system described has a total circulating power of less than 10%. Some advantages of a pulsed system with respect to a steady-state system are outlined. (auth)

23225 UNIVERSITY OF WISCONSIN FUSION DESIGN STUDIES. Maynard, C. W.; Forsen, H. K. (Univ. of Wisconsin, Madison). pp 1288-1293 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The University of Wisconsin fusion design effort is directed initially to a low-β toroidal reactor. The studies are described in terms of parts of the system moving from the center outward with remarks on fuel handling and materials at appropriate points. The plasma is central geometrically and technically, and self consistent parameters for operating points have been generated in the presence of radiation energy loss enhancement by impurities and particle confinement spoiling. A poloidal divertor produced by both superconducting and regular windings is described. Materials problems of the first wall are discussed with emphasis on radiation effects. Heat removal is discussed with representative results for wall structure, and coolant temperatures and pressure for helium cooling. The special neutronics problems of the high-energy neutrons are reviewed and the present state of the calculational model and data are stated. Some aspects of the tritium breeding and handling problem are covered that are likely to be independent of technology. Finally, magnet design is discussed in terms of the costs associated with large high-field systems which are dominated by mechanical stress considerations. (auth)

23226 NEUTRONICS OF SUBCRITICAL FAST-FISSION BLANKETS FOR D–T FUSION REACTORS. Lee, J. D. (Univ. of California, Livermore). pp 1294-1298 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The coupling of fusion and fission has the potential of significantly reducing plasma confinement criteria below that required for a pure fusion system while also reducing fissile-fuel doubling times below those possible with pure fission systems. To give a better feeling for fusion–fission's potential, and problems, a neutronic appraisal of the subcritical fast fission blanket concept is presented. Results indicate energy increases over nonfission blankets of a factor of 10 to 20 (250 to 500 MeV per 14 MeV fusion neutron) are possible in blankets where tritium breeding, cooling, structure, and fissile fuel breeding requirements are considered. (auth)

23227 PHYSICOCHEMICAL PROBLEMS OF THE D-T FUSION REACTOR TECHNOLOGY. Ihle, H. (Kernforschungsanlage, Juelich, Ger.); Stoecklin, G.; Jordan, H. L. Chem. Ing.-Tech.; 45: No. 10A, 621-631(1973). (In German).

A short review is given on the plasma physical basis of the D–T nuclear fusion reaction (e.g., heating, magnetic confinement, fuel). Using a model for the fundamental building of a fusion reactor, the following problems are discussed: choice of material, vacuum wall (in particular, radiation damage, transmutations, sputtering), breeding blanket (tritium breeding rate, thermodynamics of the Li–H system) and the tritium recovery system. (GE)

23228 FIELD DISTRIBUTION NEAR A GAP FORMED BY SECTIONALIZED SHELLS OF A TOKAMAK-TYPE APPARATUS. Sometani, T. (Shizuoka Univ., Hamamasu, Japan). Jap. J. Appl. Phys.; 11: No. 8, 1181-1186(Aug 1972).

A perturbed magnetic field distribution near a gap, which is formed by electrically conducting sectionalized shells used in a Tokamak-type plasma apparatus, is investigated analytically by making use of a Schwarz–Christoffel's transformation. The relative field distribution is dependent only on the ratio of the width of the gap to the thickness of the shell. If the presence of the gap is regarded as an edge effect and the range concerned is limited substantially within a certain distance from the edge of the shell, then it is possible to make an estimate on the absolute value of the perturbed field. The toroidal effect has been considered as a perturbation to a cylindrical solution by introducing an effective eccentric distance of a plasma current with respect to the shell. A numerical calculation of the perturbed magnetic field has been carried out for the dimensions of a Tokamak-type plasma apparatus (JFT-2) under construction. (auth)

23229 POSSIBILITY OF MICROFISSION CHAIN REACTIONS AND THEIR APPLICATION TO THE CONTROLLED RELEASE OF THERMONUCLEAR ENERGY. Winterberg, F. (Univ. of Nevada, Las Vegas). Z. Naturforsch.; 28A: No. 6, 900-906 (1973).

It is shown that, by applying the concept of high-density compression to a pellet consisting of fissionable material such as ^{235}U, ^{239}Pu, or ^{233}U, the critical mass for the initiation of a fission chain reaction in these materials can be reduced by many orders of magnitude raising the possibility of micro-fission explosions with laser energy inputs for compression within the expected reach of laser technology. Alternatively, the pellet compression may be also achieved by the employment of intense relativistic

electron beams. In addition, by surrounding the fissionable pellet with a layer of dense T–D material to be compressed together with the pellet, the minimum pellet size can be furthermore reduced by neutron reflection from the high-neutron albedo T–D shell. For fissionable pellets without a reflector the critical mass can be as small as approximately 0.3 g requiring a laser energy input for compression of several megajoule. For a pellet surrounded by a T–D reflector, the critical mass can be reduced down to approximately 10^{-3} g with a laser energy input for compression of several 10^5 joule. In addition to the neutron albedo effect of the T-D shell, there is a bootstrap mechanism whereby the T–D mantle achieves thermonuclear temperatures resulting in the emission of thermonuclear reaction neutrons into the fissionable pellet causing more fission reactions and thereby raising the temperature of the pellet. This then, in turn, will lead to an additional heating of the T–D blanket resulting in an increased flux of thermonuclear neutrons, raising the fission rate even further. Because of the greatly increased material density, a fission chain reaction initiated in it will grow in proportion much faster than in uncompressed fissionable material as it is being used in conventional fission bombs. (GE)

23230 THERMONUCLEAR RESEARCH ACHIEVEMENTS. Pease, R. Arch. Energiewirt.; 27: No. 11, 541-554(1973). (In German).

A survey of up to date important scientific knowledge contributing to the technical evaluation of fusion is given: high-temperature physics in plasmas (laser scattering, nonlinear electrical conductivity, Bohm-diffusion), magnetic inclusion (instabilities and diffusion processes) and pinch effects. Finally the most promising technical approaches are explained: levitron, toroidal pinch and stellarators. (GE)

23231 ENERGY BALANCE IN A HYBRID FUSION–FISSION REACTOR. Powell, C.; Hahn, O. J. (Univ. of Kentucky, Lexington). Atomkernenergie; 21: No. 3, 175-178(1973).

In such a reactor, neutrons from a deuterium-burning plasma would be used to fission ^{238}U in a blanket surrounding the plasma. Most of the reactor's power output would come from fission. Some of the thermal power from the blanket could be converted to electricity and transferred to the plasma, thus reducing the required confinement time and plasma temperature. A hybrid reactor would be much easier to build than a pure-fusion reactor, since the plasma in the hybrid reactor would not have to be self-sustaining, and would not have to be heated to such a high temperature for startup. And the hybrid reactor would permit the use of ^{238}U as a nuclear fuel without a slow breeding cycle. Of course, the hybrid reactor would produce far more radioactive waste and would contain a much larger inventory of radioactive material than the pure-fusion reactor. A very simple mathematical model is adequate for the purpose of this study. An energy-balance equation for the plasma, and five particle conservation equations, one for each of the ionic species in the plasma, are given. A numerical procedure for the solution of this set of equations is described, and some results are given. (GE)

23232 SOME ENGINEERING PROBLEMS OF CONTROLLED NUCLEAR FUSION. George, D. W. (Univ. of Sydney). Mech. Chem. Eng. Trans.; MC8: No. 2, 136-140(Nov 1972).

The progress towards controlled fusion reactions is briefly discussed with a view to examining some of the engineering and technological problems associated with hypothetical reactor designs. (MOW)

Wave Phenomena

23233 (COO-3632-8) OBSERVATION OF THE BEAM-PLASMA INTERACTION BELOW THRESHOLD. Conrad, J. R.; Diaz, C. J.; Walsh, J. E. (Dartmouth Coll., Hanover, N. H. (USA). Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-3632. 31p. Dep. NTIS $3.75.

The wave spectrum of longitudinal electrostatic fluctuations of a beam–plasma system was studied in the regime below the threshold for exponentially growing waves. The observed wave spectrum consists of a series of triplets, one set for each natural mode of the magnetized, cylindrical, axially bounded plasma column. The line shape and intensity of the triplets are in good agreement with a simple theory based on the linearized dispersion relation. (auth)

23234 (JPRS-59885) WAVES, INSTABILITIES, AND ANOMALOUS DISSIPATION OF A PARAMETRIC PLASMA (IN THE STRONG ELECTROMAGNETIC FIELD OF A PUMPING WAVE). Silin, V. P. 24 Aug 1973. Translation of Volny, Neustoychivosti, I Anomal'naya Dissipatsiya Parametricheskoy Plazmy (V Sil'nom Elektromagnitnom Pole Volny Nakachki). 31p. NTIS.

Nonlinear processes of exciting waves in a plasma are reviewed. (69 references) (auth)

23235 (JUL-926-PP) EXPERIMENTAL INVESTIGATIONS OF COLLISION-DOMINATED SHOCK WAVES IN A DEUTERIUM PLASMA WITH NO MAGNETIC FIELD. Siemsen, F. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Feb 1973. 62p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Thesis. Submitted to Bochum Univ. (West Germany).

The following detailed results were obtained in a theta-pinch apparatus (Mach number 3 or 3.8; density 7 or $4 \times 10^{14}/cm^3$; temperature 1.3 or 1.1 eV): The temperature jump of the electrons and ions at the shock front corresponds with the expected value. The density at the point of maximum temperature is the same as the final calculated value without taking ionization into account. The degree of ionization in front of the shock front can be calculated from the maximum density of the shock wave. Density and velocity of the reflected wave have the expected value. The increase in length of the shock-wave plateau agrees with the calculated value using cylinder geometry. It has been shown that, in a forward direction, the laser light is scattered by thermal fluctuations. The plasma is thus collision-dominated. The pressure balance could be tested and confirmed. The slight difference between the ion and electron temperature shows that the temperature relaxation is not smaller than theory predicts. An exact determination was not possible due to the limit of error of the ion and electron temperature. As in the range of values used, the measured length of the increase in electron temperature agrees with the calculated one, the validity of the model for the thermal conductivity of electrons is confirmed. In the region investigated, the transport coefficient is collision-dominated. There is a remarkable agreement of measured and calculated results for the shock-wave parameters investigated. It was not possible to test the ion viscosity. (GE)

23236 OBSERVATION CONDITIONS FOR SPATIAL ELECTROMAGNETIC ECHOES IN A MAGNETOPLASMA. Khiet, T.; Furutani, Y. (Univ., Paris). Plasma Phys.; 15: No. 6, 543-564(Jun 1973). (In French).

A search has been made for the optimum observation conditions realizable in most laboratory plasmas for the theoretically predicted spatial electromagnetic echoes. Detailed discussions are given in the case of both an infinite plasma and a bounded plasma waveguide. The existence of the echoes is not yet experimentally confirmed. (auth)

23237 PROPAGATION OF ELECTROMAGNETIC WAVES IN A PLASMA. Soni, R. C. (Government Coll., Jhalawar, India). Indian J. Phys.; 47: No. 1, 11-15(Jan 1973).

Taking collisions into account, the problem of propagation of EM waves in a plasma, free from any external electric or magnetic field is studied classically through the use of Boltzmann equation and Maxwell's field equations following Van Kampen's method of stationary solutions. The dispersion relation is obtained and is discussed in detail. It was found that, in the zero temperature region, a strong damping occurs in case of very-low-frequency waves. In the collisionless case, a type of resonance occurs in case of high-frequency waves, the resonant frequency being independent of the temperature of the plasma. (auth)

23238 OBSERVATION OF STABLE, HIGH-MACH-NUMBER COLLISIONLESS ELECTROSTATIC SHOCKS. Honzawa, T. (Nagoya Univ., Japan). Plasma Phys.; 15: No. 6, 467-474(Jun 1973).

Observation of large-amplitude ion acoustic shocks with a high Mach number up to two in a collisionless laboratory plasma characterized by $T_e/T_i \sim 10$ is described. Although they have large fluctuations behind the front, these shocks are almost laminar rather than turbulent, and they behave nonstationarily during propagation. A discussion about the upper critical Mach number for the excitation of laminar shocks and the behavior of the shocks is also presented. (auth)

23239 NONAXISYMMETRIC ALFVEN WAVE PROPAGATION IN AN ARGON PLASMA. Paoloni, F. J. (Univ., Sydney). Plasma Phys.; 15: No. 6, 475-481(Jun 1973).

The dispersion relation and the radial distribution of the wave fields of $m = \pm 1$ Alfven waves propagating in a cylindrical plasma have been calculated. It was assumed that a vacuum existed between the uniform plasma and the infinitely conducting boundary and consequently two boundary conditions were imposed on the wave fields; one on the radial current density and another on the radial magnetic field. The results are in better agreement with observations than some previous calculations that imposed a boundary condition on the radial magnetic field only. (auth)

23240 COMPREHENSIVE THEORY OF rf ENERGY ABSORPTION BY A HOT ION–ELECTRON PLASMA CYLINDER EXCITED BY AN ARBITRARY ELECTROMAGNETIC FIELD.

Messiaen, A. M.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). Plasma Phys.; 15: No. 6, 505-533(Jun 1973).

The general electromagnetic problem of coupling a magnetized, hot electron–ion plasma column to an arbitrary rf exciting field which is periodic along the column axis is considered. The plasma is described by fluid theory and the absorbed rf power is computed in a broad frequency range. The influence of all parameters is systematically investigated and the effects of axial propagation, electron temperature, TE or TM mode of exciting field and boundedness of the plasma are emphasized. Finally, the distribution of rf energy between ions and electrons is discussed. (auth)

23241 DISPERSION OF ION LANDAU DAMPING OF ION WAVES IN PLASMA. Watanabe, S.; Tanaca, H. (Yokohama National Univ., Japan). Plasma Phys.; 15: No. 6, 501-504(Jun 1973).

The propagation of ion waves with frequency below 0.6 of the ion plasma frequency is studied experimentally. The Landau damping rate increases exponentially when the frequency of the ion wave approaches the ion plasma frequency, while its phase velocity decreases slightly. The results are compared with theory and good agreement is obtained. (auth)

23242 TRANSFORMATION OF HIGH FREQUENCY WAVES AND VANISHING OF LOW FREQUENCY INSTABILITIES IN A RADIALLY INHOMOGENEOUS BEAM–PLASMA DISCHARGE. Kornilov, E. A.; Krivoruchko, S. M.; Moiseev, S. S. (Physical Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 17: No. 8, 292-294(20 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 8, 409-413(20 Apr 1973).

The influence of transformation of high-frequency waves on the operating regime of a plasma-beam discharge is analyzed. Experiments show that, by varying the radial distribution of the plasma density, it is possible to ensure effective radiation of the oscillations near the upper hybrid resonance and, by the same token, prevent transfer of the energy into the low-frequency oscillations. The latter quench the low-frequency instabilities in a plasma–beam discharge. (auth)

23243 DECAY OF MHD WAVES BY PHASE MIXING. Part 1. The Sheet-Pinch in Plane Geometry. Tataronis, J.; Grossmann, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Phys.; 261: No. 3, 203-216(1973).

It is well known that the linearized equations of motion of ideal MHD waves possess a continuous spectrum that leads to damping of propagating waves through phase mixing. It is shown how this arises by examining the dispersion relation for plasmas with nonuniform profiles and comparing the results with those of a sharp boundary model. The special case of the nonuniform sheet pinch is examined in order to present the mathematical details as clearly as possible. It is shown that, as a result of the nonuniformity, the frequency of the waves is a complex quantity having a real and imaginary part. The corresponding eigenfunctions and their mathematical degeneracy are discussed. (GE)

23244 DECAY INSTABILITY OF ION-ACOUSTIC WAVE TRAIN (OR SOLITON) AND FORMATION OF THE SHOCK PROFILE. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Commission, Cairo). Z. Phys.; 261: No. 1, 25-36(1973).

The stability of a periodic ion-acoustic wave of a finite amplitude propagating in a nonisothermal plasma is investigated. It is demonstrated that such a wave is unstable with respect to the splitting into a large number of satellite waves with effective wave numbers different from the wave number of the initial wave. The phase velocity of the satellite waves differs, therefore, from that of the initial pulse. Hence, the satellite waves with larger phase velocity will "overtake" the initial pulse and turbulize the upstream plasma. The scattering of ions and electrons by the fluctuations of electric field of turbulent oscillations will cause the energy dissipation of the initial ion acoustic wave translational motion and produce a collisionless shock wave. (GE)

23245 CURRENT-DRIVEN ION-WAVE INSTABILITY IN A WEAKLY IONIZED COLLISIONAL MAGNETOPLASMA. Kaw, P. (Physical Research Lab., Ahmedabad, India). Phys. Lett.; 44A: No. 6, 427-428(16 Jul 1973).

Ion waves propagating nearly across the magnetic field in a weakly ionized plasma with cross-field electron streaming are shown to be unstable due to dissipative effects. (auth)

23246 OBSERVATION OF INCREASE OF HIGH-FREQUENCY FIELD IN A RESONANT INHOMOGENEOUS-PLASMA LAYER. Grigor'eva, L. I.; Smerdov, B. I.; Sapogov, S. A.; Chechkin, V. V. (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 17: No. 10, 391-393(20 May 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 10, 541-544(20 May 1973).

An experimental observation of a sharp increase in the azimuthal magnetic field H_ϕ of an ion-cyclotron wave in the region of the so-called resonant layer of an inhomogeneous plasma is reported. In this layer, the square of the longitudinal refractive index $n_\parallel = k_\parallel c/\omega$ is close in value to the component $\epsilon_1 = -\omega_{pi}^2/(\omega^2-\omega_{Hi}^2)$ of the dielectric tensor ($n_\parallel^2 \simeq \epsilon_1$, $\omega < \omega_{Hi}$). (auth)

23247 DECAY OF MHD WAVES BY PHASE MIXING. Part 2. The Theta-Pinch in Cylindrical Geometry. Grossmann, W.; Tataronis, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Phys.; 261: No. 3, 217-236(1973).

The dispersion relation for stable waves in ideal MHD plasmas with diffuse profiles was calculated. The nonuniformity in the density and magnetic field profiles gives rise to a very strong damping. Phase mixing is the mechanism responsible for the damping and can be seen to occur due to the presence of the continuous spectrum of the MHD equations of motion. The special case of the linear theta pinch is examined in detail. In particular, damping coefficients for torsional Alfven waves are computed that agree very well with a rather wide range of experimental findings. (GE)

23248 COUPLED FIELDS IN STRATIFIED PLASMAS WITH TENSOR PRESSURE PERTURBATIONS. Burman, R.; Anderson, W. C. (Univ. of Western Australia, Nedlands). Czech. J. Phys.; 23: No. 8, 785-797(1973).

Small-amplitude waves in horizontally stratified, continuously varying plasmas with anisotropic electron pressure perturbations are investigated. First, two pairs of second-order coupled wave equations are obtained. Then, sets of equations in first-order matrix form are derived. One such set, which describes two kinds of vertically propagating transverse waves, is treated by the method of Clemmow and Heading. It is then transformed by Heading's method into a form that is valid throughout reflection regions, and from which a pair of second-order coupled wave equations in Foersterling's form is obtained. (auth)

23249 NONLINEAR PLASMA OSCILLATIONS IN TERMS OF VAN KAMPEN MODES. Best, R. W. B. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Physica; 64: No. 2, 387-402(1 Mar 1973).

A solution for the equations of Vlasov and Poisson describing one-dimensional plasma motion is discussed. The solution involves expansions to second order in the field amplitude. At first order, the Van Kampen modes are recovered. The second-order calculations are free from the usual secular terms and squares of delta functions. Finally, an expression is found for the distribution function in which Van Kampen modes also dominate the second-order term. (auth)

23250 LOWER HYBRID RESONANCE IN AN INHOMOGENEOUS COLD AND COLLISIONLESS PLASMA SLAB. Lazzaro, E.; Maroli, C. (Univ., Milan). Nuovo Cim., 16B: No. 1, 44-54 (11 Jul 1973).

Purely electrostatic modes in a cold plasma slab were analyzed, with emphasis on those cases in which the lower hybrid resonance is present inside the plasma. The corresponding boundary value problem was solved, in the limit in which the parallel wave number k goes to infinity. Accessibility of the hybrid resonance was pointed out, in the alternative limit $k \to 0$. Volume resonances for both inhomogeneous and homogeneous and finite slabs were considered as equally interesting at the present level of description. (auth)

23251 OBLIQUE ELECTROMAGNETIC WAVE PROPAGATION IN A MAGNETIZED INHOMOGENEOUS PLASMA. Fichet, M.; Fidone, I. (CEN, Fontenay-aux-Roses, France). Nuovo Cim.; 16B: No. 1, 221-239(11 Jul 1973). (In French).

The oblique propagation of electromagnetic waves in a cold, inhomogeneous and magnetized plasma was studied. The plasma is inhomogeneous in one direction only, perpendicular to the external magnetic field B_0. The plane of incidence contains the density gradient and B_0. In this case there is no lateral deviation. After a general presentation, only the hf propagation is analyzed. The second-order coupled equations given by Clemmow and Heading are given. In a smooth plasma WKB solutions are good outside six levels. With the WKB approximation, the Poynting vector associated with the four characteristic waves is described and the different possibilities for the associated ray paths are discussed. (auth)

23252 INFLUENCE OF TEMPERATURE EFFECTS AND PARTICLE TRAPPING BY PLASMA WAVES ON DISPERSION PROPERTIES OF NONLINEAR WAVES. Demutskii, V. P.; Polovin, R. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 5, 819-823(May 1973). (In Russian).

The influence of the thermal motion of particles and their trapping by plasma waves on dispersion properties of weakly nonlinear

waves was studied. One-dimensional electrostatic nonlinear oscillations are considered in the system consisting of several interpenetrating beams. It is proved the thermal motion produces a destabilizing effect, while the particle trapping by plasma waves stabilizes oscillations if the density of the particles decreases with growth of their potential energy. (auth)

23253 ANOMALOUS PROPAGATION OF GRID-EXCITED WAVES IN A PLASMA. Ichikawa, M.; Sata, M. (Yamagata Univ., Yonezawa, Japan). Phys. Lett.; 44A: No. 5, 335-336(2 Jul 1973).

Discontinuous phase velocity variation of the wave propagation is observed for low-frequency perturbations excited by a grid in a plasma. The abrupt change of the velocity is closely related to oscillatory damping of the wave amplitude and becomes more conspicuous with the exciting frequency. (auth)

23254 INFLUENCE OF TRANSVERSE MAGNETIC FIELD ON LANDAU DAMPING. Sagdeev, R. Z.; Shapiro, V. D. JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 279-282(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 7, 389-394(5 Apr 1973).

The presence of an arbitrarily weak transverse magnetic field in the linear theory leads to the paradox wherein the damping vanishes because of continuous Landau resonance $\delta(\omega - kv)$ gives way to discrete resonances $\delta(\omega - n\omega_H)$, where $\omega_H = eH/mc$ and $n = \pm 1$ and ± 2. This paradox is resolved, in particular, if the limit is taken correctly with allowance for the fact that as H decreases ω_H becomes ultimately smaller than $1/\tau_0$ ($\tau_0 = \sqrt{m/eEk}$ is the period of the oscillations of the trapped particles and E is the amplitude of the electric field), and the discrete resonances overlap, $\Delta\omega \sim 1/\tau_0 > \omega_H$. The nonlinear effects in the damping then become significant. Separate analyses are presented for trapped and untrapped particle trajectories in magnetic fields. (MOW)

23255 COMPUTATIONAL STUDY OF SHOCK WAVES. Chu, C. K. (Columbia Univ., New York). Contract AT(30-1)-3954. pp 101-112 of Dynamics of Ionized Gases. Lighthill, M. J. (ed.). Tokyo; Univ. of Tokyo Press (1973).

From proceedings of the international symposium on dynamics of ionized gases; Tokyo, Japan (13 Sep 1971).

Three recent computational studies on shock waves carried out at Columbia University Plasma Research Laboratory are described. The first work, related to Q-machine experiments, is the formation of ion-acoustic collisionless shocks, obtained by a direct numerical solution of the Ulasov equation. The second, related to shock tube experiments, is a time-dependent study of the formation and structure of one-dimensional collisional shock waves, in which all physical transport properties are included. The third, also related to shock-tube experiments, is a preliminary report on the reflection and focusing of hydromagnetic shock waves from a curved wall. (MOW)

23256 DAMPING AND AMPLIFICATION OF LANGMUIR SOLITON. Krivoruchko, S. M.; Fainberg, Ya. B.; Shapiro, V. D.; Shevchenko, V. I. (Physical Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 17: No. 7, 244-247(5 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 17: No. 7, 344-348(5 Apr 1973).

The damping of a high-frequency Langmuir soliton in a Maxwellian plasma and the amplification of such a soliton by an electron beam were investigated theoretically and experimentally. (auth)

23257 EFFECT OF PLASMA RESONANCE ON PROPAGATION OF SURFACE WAVES ALONG PLASMA-VACUUM CHANNELS. Demchenko, V. V.; El-Siragy, N. M. (Atomic Energy Establishment, Cairo). Ann. Phys. (Leipzig); 29: No. 1, 47-62(1973).

An investigation is made of the effect of a homogeneous plasma–vacuum narrow transition region on the nature of surface wave propagation along the vacuum channel boundary. Dispersion equations, taking into account the collision damping of surface waves in the region where the wave frequency is equal to Langmuir frequency have been obtained. The expressions for damping coefficients of surface waves were found both for the plane and the cylindrical geometry. Transformation of surface waves into longitudinal oscillations in the transition layer is also obtained. For a period of time, determined by the transition layer width, the surface waves, caused by initial perturbation, were demonstrated to transform into longitudinal oscillations concentrated in the plasma–vacuum transition layer and directed along the gradient of plasma density. (auth)

23258 ANOMALOUS DISSIPATION AND PENETRATION OF STRONG ELECTROMAGNETIC RADIATION INTO A BOUNDED PLASMA. Aliev, Yu. M.; Gradov, O. M.; Kirii, A. Yu. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 3, 126-128(5 Feb 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 3, 177-179(5 Feb 1973).

The stationary picture of penetration of a transverse wave with frequency close to the plasma frequency into a bounded plasma is considered. The parametric growth of the longitudinal noise leads to a considerable increase of the effective collision frequency and to a decrease of the wave penetration in comparison with the usual "collision" values. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 21731, 22067, 22086, 22436, 23010, and 23877.

23259 (CONF-730907-3) DOSE FROM PHOTON EMITTERS DISTRIBUTED UNIFORMLY IN THE TOTAL BODY AS A FUNCTION OF AGE. Hilyer, M. J. C.; Hill, G. S.; Warner, G. G. (Oak Ridge National Lab., Tenn.). 1973. 13p. Dep. NTIS $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

The radiation doses from six monoenergetic radioisotope photon sources, ranging from 20 keV to 2 MeV, distributed uniformly in the body of newborn infants, children of several ages, and young adults were calculated using computer analysis of decay data and modified anthropomorphic phantoms. The radiation dose absorbed by target organs (gonads, liver, and skin) was considered to be directly proportional to the density of the body part and the dose rate in the target organ was considered to be proportional to that fraction of emitted energy that was absorbed per gram of target tissue. Estimates of the specific absorbed energy fractions were obtained using the Monte Carlo technique. (CH)

23260 (EIR-231) COMPARISON OF THE SPACE LEGENDRE POLYNOMIALS APPROACH WITH OTHER METHODS USED FOR THE SOLUTION OF THE INTEGRAL TRANSPORT EQUATION. Stepanek, J. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1972. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

The solution of integral transport equation by means of space Legendre polynomials series for the monoenergetic critical slab problem is presented in many details. The properties of the transport matrices, in particular, the important recurrence formulas between matrix elements are discussed. This method is compared to many other methods. The eigenvalues, center/boundary flux ratios and the integrated fluxes are given for optical thicknesses of the slab $\tilde{d}$ = 0.01, 0.1, 1.0, 10.0 and 100.0. The Legendre polynomial approach is also compared to some modified versions of the method. (auth)

23261 (LA-5300-MS) PHYSICS INPUT TO NEGATIVE PION THERAPY. Reidy, J. J.; Knowles, H. B. (Los Alamos Scientific Lab., N. Mex.). Jun 1973. Contract W-7405-eng-36. 55p. Dep. NTIS $5.45.

Information, views, opinions, and prejudices among various individuals at Los Alamos Scientific Laboratory during the summer of 1972 who were interested in the pion radiotherapy program are presented in the eight papers included. (CH)

For title listings of selected papers see: 21513, 23085, 23263, and 23264.

23262 (ORNL-4902(Vol.1)) NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1973. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 74p. Dep. NTIS $5.45.

After an introduction devoted to elements of radiation shielding analysis and reactor core analysis, the bulk of the material is presented in five sections, as follows: theoretical studies of medium- and high-energy radiation transport, medium-energy nucleon spectroscopy, weapons radiation cross-section studies, weapons radiation shielding, and radiation shielding information center. Most of the items are of a descriptive nature, and fairly short: many are abstracts of papers or reports that have appeared elsewhere. A list of publications and papers presented at scientific meetings is included. (RWR)

23263 (ORNL-4902(Vol.1), pp 10-13) COMPARISON OF THE ABSORBED DOSE FROM NEGATIVELY CHARGED PIONS, PROTONS, AND NEUTRONS. Alsmiller, R. G. Jr.; Santoro, R. T.; Barish, J. Aug 1973.

In Neutron Physics Division annual progress report for period ending May 31, 1973.

23264 (ORNL-4902(Vol.1), pp 16-18) EFFECT OF BONE IN THE USE OF NEGATIVELY CHARGED PIONS IN CANCER RADIOTHERAPY. Santoro, R. T.; Alsmiller, R. G. Jr.; Chandler, K. C. Aug 1973.

In Neutron Physics Division annual progress report for period ending May 31, 1973.

23265 MATCHING OF ADJACENT FIELDS IN RADIOTHERAPY. Armstrong, D. I.; Tait, J. J. (Christchurch Hospital, N. Z.). Radiology; 108: No. 2, 419-422(Aug 1973).

Field-matching of radiation beams can introduce very large dosage errors across the junction. A simple method of generating a wide penumbra so that the probability and magnitude of these errors may be reduced to acceptable levels is described. (auth)

23266 NEW SYSTEM OF FIELD SHAPING FOR EXTERNAL-BEAM RADIATION THERAPY. Powers, W. E.; Kinzie, J. J.; Demidecki, A. J.; Bradfield, J. S.; Feldman, A. (Mallinckrodt Inst. of Radiology, St. Louis). Radiology; 108: No. 2, 407-411 (Aug 1973).

A new system for designing and shaping teletherapy treatment fields to any form or size is described. A low-melting alloy, Lipowitz's metal, is cast in a styrofoam form which was cut with a hot-wire device. A one-piece assembly is produced for each patient. In daily application the block assembly is simply and quickly indexed into correct position in the head of the therapy unit and is held securely regardless of the head angulation. Materials are salvaged and reused upon completion of the treatment course. The system has been shown to be accurate and reproducible. (auth)

23267 OPTICAL MINIFIER FOR SHIELDING-BLOCK DESIGN IN EXTERNAL-BEAM RADIATION THERAPY. Rao, G. U. V.; El-Mahdi, A. M. (Johns Hopkins Hospital, Baltimore). Radiology; 108: No. 2, 412(Aug 1973).

An optical minifier for use in shielding-block design in external-beam radiation therapy is described. Studies of this device in the design of individualized shields such as mantle and kidney blocks indicate that it is substantially quicker and far less expensive than available commercial systems. (auth)

23268 MULTIPLE COHERENT SCATTERING OF γ RADIATION. Uchaikin, V. V.; Potapov, V. N. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 129-132 (1973). (In Russian).

The solution of the kinetic equation $\sigma(\theta) = a[\eta^2 + \theta^2]^{-2}$ is examined for three types of sources in infinite homogeneous medium. The three sources examined are plane perpendicular sources, point isotropic sources, and point collimated sources. A numerical example is given. (JSR)

23269 INDIRECT DETERMINATION OF THE ENERGY LOSS OF PROTONS CHANNELED IN SILICON SINGLE CRYSTALS. Della Mea, G.; Drigo, A. V.; Lo Russo, S.; Mazzoldi, P. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 52: No. 5, 727-733(May 1972).

The energy loss coefficient, $\alpha = (dE/dx)_c/(dE/dx)_N$ (c = channeled, N = nonchanneled), for protons channeled along ⟨111⟩ in Si was determined using the $^{28}Si(p,\gamma)^{29}P$ nuclear reaction and large-angle Rutherford scattering of the protons. The mean α value found is 0.58 ± 0.04 for 1600-keV protons, in good agreement with transmission results. The dechanneled fraction at the surface is $\chi_{min}(0) = 2.8 \pm 0.3\%$. (DLC)

23270 COMPOSITION OF HIGH-ENERGY HEAVY-ION BEAMS: PRELIMINARY MEASUREMENTS. Maccabee, H. D. (Univ. of California, Berkeley). Radiat. Res.; 54: No. 3, 495-508(Jun 1973).

Silicon semiconductor detector systems were used to measure the energy-deposition spectra of 240-MeV/nucleon oxygen ion beams at the Bevatron of Lawrence Berkeley Laboratory. The results are useful for determining the composition of the beam, before and after passing through varying thicknesses of water absorber. In particular, contamination of the incident oxygen beam by carbon ions on the order of 1% was detected and resolved. Secondary particles due to nuclear fragmentation in water were identified and quantified. The experimental estimate of the mean free path of fast oxygen ions in water is 20 g/cm^2, in agreement with calculations from cosmic ray data and geometric cross sections. (auth)

23271 PROTON ENERGY DEGRADATION IN WATER VAPOR. Miller, J. H.; Green, A. E. S. (Univ. of Florida, Gainesville). Radiat. Res.; 54: No. 3, 343-363(Jun 1973).

Proton energy degradation, the fate of the energy lost by protons in slowing down, is analyzed from a microscopic point of view for protons of 0.5 to 10^4 keV in water vapor. The analysis is based on the assignment of cross sections for the excitation of the H_2O molecule by proton and neutral hydrogen impact. Given these cross sections and the efficiencies for electron degradation in water vapor, the efficiency for population of ionization continua, dissociative continua, and bound excited states of H_2O after complete degradation of the proton is calculated. Each efficiency includes

the contribution from direct proton excitation, excitation by neutral hydrogen produced in charge exchange reactions, and excitation by secondary electrons are calculated. The average energy lost per ion pair is calculated and a value of approximately 25 eV at high energies obtained. (auth)

23272 THERMOMODULATION PROCEDURE FOR ELECTRON-ENERGY-LOSS ANALYSIS. Breuer, K. (Zentralinstitut fuer Elektronenphysik, Berlin). Exp. Tech. Phys.; 21: No. 1, 51-57(1973). (In German).

There is described a thermomodulation procedure for energy-loss measurements with fast electrons. The variation of temperature is obtained by means of irradiation with laser light. The high density of irradiation guarantees high temperatures, and the necessarily thin foils of the investigated material guarantee fast temperature variations by working with intermittent light. The thermomodulation procedure is demonstrated on energy-loss experiments on Al and Al_2O_3 foils. The differences of temperatures are measured by means of the shifts of the volume plasma losses. (auth)

23273 ENERGY DEPENDENCE OF DYNAMIC STRESSES PRODUCED WHEN RELATIVISTIC CHARGED PARTICLES PASS THROUGH A SOLID. Kalashnikov, N. P. (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 17: No. 8, 311-313(20 Apr 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 8, 435-437(20 Apr 1973).

The excitation of mechanical vibrations in a thin metallic target by the passage of relativistic charged particles is considered. The main problem of the interaction between charged particles and elastic waves reduces to a determination of the explicit form of the force per unit volume of the material. (Previous work took no account of the direct generation of a stress tensor by the electromagnetic field of the passing particle.) An expression is derived for the average force per unit time, and it is found that the passing particle acts on a thin target with an average force proportional to the energy of the incident particle. The amplitude of the acoustic oscillations increases linearly with the energy of the incident particles, and the total force due to passage of a beam of charged particles is proportional to the number of particles in the pulse. The force exerted by the passing particle on the target can exceed, with increasing energy, the force due to the ionization loss. The linear energy dependence of the acoustic-oscillation amplitude makes it possible to use the indicated mechanism to detect the energy of high-energy particles. (RWR)

23274 LUNG-EQUIVALENT MATERIAL FOR FAST NEUTRON DOSE DISTRIBUTION STUDIES. McGinley, P. H. (Longwood Coll., Farmville, VA). Int. J. Appl. Radiat. Isotop.; 24: No. 8, 477-478(Aug 1973).

A realistic phantom containing simulated lung components consisting of granulated muscle-equivalent plastic with a density of 0.38 g/cm^3 is described. To evaluate the performance of the lung phantom depth-dose values were obtained for a diverging 14.7 MeV neutron beam with a size of approximately 18 × 18 cm at the front surface of the phantom and these are reported. (UK)

23275 STUDIES ON A VARIABLE COMPENSATING FILTER FOR RADIOTHERAPY OF THE NECK REGION. Tatsuno, I.; Izumi, N.; Takeda, I. (National Hospital of Kanazawa, Japan). Iryo; 26: No. 12, 1077-1081(Dec 1972). (In Japanese).

An attempt was made to fabricate a variable compensating filter to obtain a more homogeneous dose distribution in the neck region using Linac x-ray radiation. The following simplified formula (Tsunemoto, 1965) to make the variable compensating filter was adopted. $t = (1/\lambda)\cdot\mu x$, $\tan\alpha = (f/w)\cdot(1/\lambda)\cdot\mu x$, in which t stands for thickness of filter, x for thickness of tissue, corresponding with the thickness of t, f for target skin distance, a for target diaphragm distance, w for field size, α for angle of the filter, μ for the effective linear absorption coefficient for water, and λ for the linear absorption coefficient of the compensating material. The filter material was an 8 mm thick, 1.18 g/cm^3 plastic plate. The 7 plates made one block compensator by placing one above the other and were easily adjusted by sliding along the contour line of the neck. A μ of 0.0477 cm^{-1}, x of 5 cm, λ of 0.0562 cm^{-1}, and w of 5 × 5 cm was adopted. The thickness and the angle of the compensating filter were calculated as 4.2 cm and 53 degrees respectively by the formula. The series of dose distributions were compared without filters and with triangular and parabolic filters by single and two portal opposing field x-ray radiation from the 6 MeV Linac. Industrial x-ray film was exposed and the isodose distribution was obtained. The maximum dose was at a depth near the skin surface of the median line of the front neck without a filter. An excellent dose distribution for the neck region was easily obtained with the variable compensating filter so that it can be applied for routine clinical use. (auth)

23276 CHARGE CHANGING OF ENERGETIC HEAVY IONS IN GASES. Tonuma, T.; Kohno, I.; Miyazawa, Y.; Yoshida, F.; Karasawa, T. (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys. Soc. Jap.; 34: No. 1, 148-155(Jan 1973).

The electron loss and capture cross sections of carbon (σ_{45}, σ_{56},σ_{68}) and of nitrogen ions (σ_{45},σ_{56},σ_{67},σ_{78}) in H_2, He, N_2, Ne, Ar, Kr and Xe gases were measured at energies of 3.5 to 7.5 MeV/nucl. As the result, it has been found that cross sections for single electron loss of those energetic heavy ions agree nearly with a formula given by N. Bohr and generalized by I. S. Dmitriev who derived the formula for electron loss in a free collision approximation through a classical treatment, and that from the relation between the electron loss cross sections and the atomic number of gaseous medium Z_{med}, the shielding effect of target gas was observed obviously in the region of $Z_{med} \gtrsim 10$. Cross sections for electron capture could not fit to previous theories, but agreed well with the calculation derived by Urata and Watanabe recently using an impulse approximation. (auth)

23277 PASSAGE OF α PARTICLES FROM ^{238}Pu THROUGH SOME GASES. Nakhutin, I. E.; Demidovich, N. N. Yadern. Fiz.; 17: No. 6, 1245-1254(Jun 1973). (In Russian).

The ranges and energy losses of α particles from ^{238}Pu were investigated in CF_4, CF_2Cl_2, SF_6, CH_4, and CO_2 by means of the semiconductor surface-barrier silicon detector. The dependence of the particle energy upon its range was obtained, as well as the dependence of the energy losses upon the particle energy. The relative stopping powers and the mean excitation energies of CF_4, CF_2Cl_2, SF_6, CH_4, and CO_2 were obtained. The law of additivity of stopping powers (Bragg's law) and the law of additivity of mean excitation energies of molecules allowed determining the relative stopping powers and mean excitation energies of fluorine, chlorine, and sulfur. (6 figures, 3 tables) (auth)

23278 ACCURATE FORMULAE FOR THE CALCULATION OF HIGH ENERGY ELECTRON BREMSSTRAHLUNG SPECTRA. Matthews, J. L.; Owens, R. O. (Univ. of Glasgow). Nucl. Instrum. Methods; 111: No. 1, 157-168(1973).

A compilation of formulas for the calculation of the bremsstrahlung spectrum for electron energies above 30 MeV is presented. The Bethe–Heitler extreme relativistic theory with intermediate screening and Coulomb correction is used with a correction for the finite Z-dependent intensity at the endpoint. The inclusion of this effect together with that of electron–electron bremsstrahlung allows these formulas to be applied over the entire photon spectrum and for any radiator atomic number, Z. The effects of electron energy loss and straggling in the radiator and the spread in incident electron energy are also taken into account. The formulas were reduced to a form convenient for computer calculations. (6 figures, 3 tables) (auth)

23279 RADIAL CUTOFF LET AND CUTOFF DOSE CALCULATIONS FOR HEAVY CHARGED PARTICLES IN WATER. Chatterjee, A.; Maccabee, H. D.; Tobias, C. A. (Univ. of California, Berkeley). Radiat. Res.; 54: No. 3, 479-494(Jun 1973).

A model was presented to calculate radial energy deposition around the trajectory of a heavy charged particle in water. The model originates from the basic concept of knock-on collisions and glancing collisions in stopping-power theory. Energy deposition by diffusive motion of low-energy electrons was included in the calculation. Available experimental data agrees reasonably well with the results of the present model. (auth)

23280 MONTE CARLO SIMULATIONS OF SCATTERING OF BOMBARDING IONS IN SOLIDS. Ishitani, T.; Shimizu, R.; Murata, K. (Osaka Univ., Suita, Japan). Jap. J. Appl. Phys.; 11: No. 2, 125-133(Feb 1972).

By taking account of not only an elastic scattering but also an inelastic scattering, the Monte Carlo technique based on a single scattering model is applied to a simulation of the behavior of ion beam in the amorphous target. The calculations are carried out for the light ion beam mainly and the results show a fairly good agreement with the experiments on the range and the backscattering. Also ion trajectories are depicted on the chart by the plotter connected with the digital computer to get a direct view of the scattering processes in solids. (auth)

23281 APPROXIMATION OF DOSE TRANSMISSION AND REFLECTION PROBABILITIES FOR GAMMA RAYS OBLIQUELY INCIDENT AND FOR A PLANE ISOTROPIC SOURCE ON FINITE CONCRETE BARRIERS. Harima, Y. (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 116, 97-113(Mar 1973).

The geometrical progression formula was applied to the approximation of the dose transmission probability for plane unidirectional γ-rays incident on concrete barriers of finite thickness. The results of the approximations are in good agreement with the basic data within the limits of errors associated with the basic data, for the energy range of 0.2 to 10 MeV, and for thicknesses up to 4

mean free paths. Two parameters of the geometrical progression formula could be represented by monotonic functions of log ($1/\cos\theta_0$) ($\cos\theta_0$: incident obliquity angle). The reflection probabilities were also represented by simple functions of $\cos\theta_0$. Therefore, the total dose rate for a plane isotropic source parallel to the barrier can be estimated easily with the above relations. (auth)

23282 COMPUTER PROGRAM FOR THE MONTE CARLO CALCULATION OF SPECTRA OF GAMMA-INDUCED ELECTRONS TRANSMITTED THROUGH MATTER. Minato, S. (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku; 22: No. 1, 23-45(Jan 1973). (In Japanese).

A program written by the FORTRAN language was prepared in order to evaluate the transmission spectra of secondary electrons produced in matter by gamma-rays. Flow-charts of the program are illustrated and each section is explained in detail. Methods for generation of random variates are concretely described and distributions of the random variates sampled are compared with theoretical distributions. Shapes of the spectra calculated by the program agreed fairly well with those obtained experimentally by other workers. (auth)

23283 CALCULATION OF DIAGNOSTIC X-RAY SPECTRA, ESPECIALLY TAKING INTO ACCOUNT SCATTERED RADIATION. Reiss, K. H.; Steinle, B. (Siemens AG, Erlangen, Ger.). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

Intensity distributions, spectra of energy and direction after penetration through simple water phantoms were calculated by the Monte Carlo Method for continuous bremsstrahlung spectra of a commercial x-ray tube at voltages of 40 to 130 kV on the tube. Comparative measurements by Ge(Li) counters are showing a good accordance. The used calculation system allows an analysis of the interaction effects. (auth)

23284 PRACTICAL METHOD FOR REDUCING DOSE MEASUREMENT ERRORS IN FILM DOSIMETRY OF HIGH-ENERGY PHOTONS AND ELECTRONS IN PHANTOMS. Rassow, J. (Staedtische Krankenanstalten, Essen). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

A systematic outline of a method for the step-wise elimination of error sources in film dosimetry in the field of radiotherapy is given. The method requires extended and improved measuring and evaluation techniques but in return leads to the complete elimination of some error sources and contributes to reducing the significance of others to a large extent. (GE)

23285 DOSIMETRY PROGRAM OF THE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT. Reich, H. (Physikalisch-Technische Bundesanstalt, Brunswick). (1972). vp. (In German).

From joint meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

The extension of the dosimetry program to include high energies and the introduction of a mandatory calibration of dosemeters for radiation protection, planned to be introduced by a federal act in 1972, called for an extension of the working group "Photon and electron dosimetry" of the PTB. Besides the present services covering the calibration of dosimeters for x rays and gamma rays up to energies equivalent to that of ^{60}Co, two new services will be available: By means of a calorimetric primary standard and several standard measuring chambers, ionization-chamber dosemeters will be calibrated in the future in a phantom for photon and electron rays up to 50 MeV. Furthermore, a calibration service with chemical dosemeters will be offered in collaboration with the NPL, London. Apart from the work currently under way to install the appropriate calibration facilities, investigations are carried out to derive various correction factors for the determination of doses. (GE)

23286 MEASUREMENT OF FAST-NEUTRON SPECTRUM IN EMERGENCY. Kramer-Ageev, E. A.; Troshin, V. S. (Moscow Engineering Physics Inst.). pp B.13.1-B.13.4 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

Experience gained in the reconstruction of neutron spectra in some nuclear reactors showed best results could be obtained utilizing the values of the integral neutron fluxes $\phi(E_i)$. They are calculated from the measured activity (Q_i), devided into the nuclei number of the isotope used as well as from the known threshold effective cross-section ($\sigma_{eff}(E_i)$). The effective cross-sections were taken from BNL-325 and elsewhere for the following characteristic spectra: fission spectrum, spectrum of neutron fission source in water, graphite, iron, as well as a neutron spectrum in the channels of the BR 5 fast reactor. The effective threshold of reactions and the cross-section itself were chosen so that an error in the cross-section of the characteristic spectra should be minimized. A range of the fluxes being measured depends on the type of the indicators used as well as on devices for activity measurements, a background, etc. For radiation bursts the minimum value of an integral neutron flux n/cm^2 at an energy above 1 MeV is 5.10^{10} n/cm^2. A radiation dose in accidents is determined by a total effect of fast, intermediate, and thermal neutrons, and gamma radiation. A gamma radiation dose can be recorded by devices that are either insensitive or slightly sensitive to neutron fluxes. In many cases its contribution is about 20 to 30%. The dose due to thermal or intermediary neutrons can be estimated from the data of activation or fission detectors. The contribution made by these neutron groups into the total dose does not exceed 30% and essentially depends on the moderators and reflectors used. Therefore, fast neutrons account for about 30 to 40% of the total radiation dose. Proceeding from the requirements for the determination of a detector activity with about 7% uncertainty, one can use the following detectors: neptunium-237, indium-15, phosphor-31, aluminium-27, and iron-56 for dosimetry in emergency. (BE)

Radiation Protection Standards

23287 (CEA-R-4434) IONOMETRIC DETERMINATION OF A STANDARD ABSORBED DOSE IN AIR USING A CAVITY CHAMBER. Sklavenitis, L.; Simoen, J. P.; Troesch, G.; Pages, L.; Tabot, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1973. 39p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

In the framework of the normalization of radiological protection dosimetric standards, the absorbed dose within a small air volume surrounded by an air thickness of 0.3 g cm^{-2} was adopted as a reference for photon dosimetry. The measurement of this reference absorbed dose was effected with a 5 cm^3 ionization chamber having 0.3 g cm^{-2} walls made of a teflon carbon mixture. The associated electronics enables very accurate automatically repeatable measurements to be made. The system measures the absorbed dose rate with an accuracy of 1% for photons having energies between 40 keV and 1.3 MeV and doses varying between 0.1 and several thousand rad h^{-1}. Smaller energies and doses can be measured, but, with less precision, the application of correction factors becoming necessary. In addition to its use in the calibration of radiological protection detectors, the chamber is very suitable for the calibration of photon beams having large or ill defined energy ranges eg beams from x-ray tubes or those used in teletherapy. (FR)

23288 (STI/PUB-257) RADIATION PROTECTION PROCEDURES. Safety Series No. 38. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 198p. IAEA $7.00.

The fundamentals of nuclear physics and interactions of ionizing radiations with matter and living cells are reviewed. The basic concepts governing the formulation of units for the measurement of radiations and the IAEA recommendations for maximum permissible levels of exposure of radiation workers and the general population are discussed. Methods used for measurements of radiations, and the selection, calibration, and maintenance of instruments used for monitoring areas, the environment, and personnel are described. Radiation control measures discussed include: shielding; basic design features for radiation installations; handling equipment for radiation sources; protective clothing; decontamination measures; radioactive waste management; the transport of radioactive materials; and emergency procedures for radiation accidents. Various administrative and technical measures which could form the basis for establishing a successful radiation protection program are discussed. A collection of useful health physics data is appended. (100 references.) (CH)

Radiation Source Calibration and Standardization

Refer also to abstracts 21447 and 21470.

Shielding Calculations and Experiments

Refer also to abstracts 22172, 23262, 23487, and 23488.

23289 NEUTRON CROSS SECTIONS FOR THE EGYPTIAN MARBLE. Gomaa, M. A.; El-Shinawy, R. M. K.; Mohamed, H. E. (Atomic Energy Commission, Cairo). Health Phys.; 25: No. 2, 175-176(Aug 1972).

To explore the use of Egyptian marble as a feasible replacement of some of the more expensive neutron shielding materials, the macroscopic neutron cross section was measured using a Pu–Be neutron source. The various types of Egyptian marble investigated in the study were white, black, berccia Rosse, alabaster, green qena, berlato, wadi harif and botchino which have $CaCO_3$, $MgCO_3$ and $Mg(OH)_2$ as their main constituents. From the results it is clear that the average total neutron cross section for Egyptian marble may vary from 0.19 to 0.12 cm^{-1} and that green qena marble and white marble attenuate Pu–Be neutrons as well as paraffin. Green qena marble, white marble and black marble can also be recommended as feasible replacements for some of the more expensive neutron shielding materials for economic reasons. (UK)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 22526, 22562, 22653, 23971, and 23974.

23290 (FRNC-R-20, pp IV.1-IV.22) LINE BUNDLES AND THE PREQUANTIZED SCHROEDINGER EQUATION. Kostant, B. (Massachusetts Inst. of Tech., Cambridge). 1972.

The notion of prequantization has already been introduced. A prequantized Schroedinger equation associated with a time dependent Hamiltonian is introduced, and it is shown how the equation arises in a natural way and its solution (wave functions) exactly correspond to the states associated with a symplectic manifold, i.e., to the sections of an appropriate line bundle. (auth)

23291 (IFA-FR-102-1973) STUDY OF THE OPERATING MECHANISM OF LIE SERIES TO SOLVE THE FORWARD KOLMOGOROV EQUATION. Cristea, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

The content of a previous method very good for computers for solving the first-order partial differential equations using the Lie series is shown. (JFP)

23292 (RL-73-33) OPTIMIZED POLYNOMIAL APPROXIMATION TO SOLVING INTEGRAL EQUATIONS: LIPPMANN-SCHWINGER EQUATION. Chao, Y. A.; Jackson, A. D. (Rutherford High Energy Lab., Chilton (England)). May 1973. 40p. Dep. NTIS (U.S. Sales Only) $4.00.

The optimized polynomial approximation is applied to solving the Lippmann-Schwinger equation. Simple prescriptions for practical usage are given for the case of a general superposition of Yukawa potentials. Detailed results are presented for the Malfliet-Tjon $^3S_1$ potential as a representative demonstration of the power of the method. For comparable accuracy it is seen that the use of optimum variables reduces the dimension of the relevant matrix equations by a factor of approximately three. (auth)

23293 GENERALIZED CHARGE IN THE EIGHT-COMPONENT SPIN-½ WAVE EQUATION. Edmonds, J. D. Jr. (Ames Research Center, Moffett Field, CA). Found. Phys.; 3: No. 3, 313-319(Sep 1973).

A conserved current is given for the hypermass generalization of the Dirac equation. The generalization of charge to an invariant quaternion is given which provides insight into a new vector space for relativistic quantum theory. This charge generalization also ensures the independence of the eight internal degrees of freedom in the wave equation. (auth)

23294 GENERALIZED MEASURE THEORY. Gudder, S. (Univ. of Denver). Found. Phys.; 3: No. 3, 399-411(Sep 1973).

It is argued that a reformulation of classical measure theory is necessary if the theory is to accurately describe measurements of physical phenomena. The postulates of a generalized measure theory are given, and the fundamentals of this theory are developed, and an introduction is given to some open questions and possible applications. Specifically, generalized measure spaces and integration theory are considered, the partial order structure is studied, and applications to hidden variables and the logic of quantum mechanics are given. (auth)

23295 DEFINITIONS OF VALIDITY APPLIED TO QUANTUM THEORIES. Benioff, P. (Argonne National Lab., IL). Found. Phys.; 3: No. 3, 359-379(Sep 1973).

Quantum theories are considered which consist in essence of a map from state preparation procedures w to states and a map from decision procedures Q to probability operator measures. Two definitions of validity, similar to that given elsewhere, are given and compared for these theories. One definition is given in terms of one carrying out of some w followed by some Q, denoted by (Q, w). The other is given in terms of infinite repetitions (Q, w) of w followed by Q. Both definitions are discussed in terms of the comparison of limit empirical means with theoretical expectation values. Particular attention is given to the use of outcome sequences of (Q, w) and of (Q, w) to determine properties of the probability measures the physical theory assigns to each (Q, w) in its domain. (auth)

23296 GREEN FUNCTIONS OF THE SCHROEDINGER EQUATION IN HOMOGENEOUS AND CONSTANT ELECTRIC AND MAGNETIC FIELDS. Thai K'uang (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 55-58(1973). (In Russian).

The Green functions of the Schroedinger equation in homogeneous and constant electric and magnetic fields were calculated by the direct method with use of the explicit expressions for the wave functions and energy spectrum. (tr-auth)

23297 CONCOMITANTS OF SPINORS OF TYPE [3/2, 1/2] IN SPACE-TIME. Dodds, B. (Heriot-Watt Univ., Edinburgh). Int. J. Theor. Phys.; 7: No. 4, 241-251(1973).

Explicit forms for the concomitants which are bilinear in two spinors of type [3/2, 1/2] and the concomitants which are quadratic in a single spinor of type [3/2, 1/2] are obtained. The dual-tensors, where they exist, are also given. The concomitants of higher-order spinors can be obtained in an exactly similar manner. (auth)

23298 SOME SYMMETRY PROPERTIES OF THE T-COEFFICIENT. Kil'dyushov, M. S.; Kuznetsov, G. I. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 6, 1330-1336(Jun 1973). (In Russian).

The graphical technique is used to study the symmetry properties of the transition coefficients between standard blocks which form the "trees" corresponding to the hyperspherical functions. (auth)

23299 COMPLETE SET OF OBSERVABLES ON THE SPHERE IN THE THREE-DIMENSIONAL COMPLEX SPACE. Lukach, I.; Totkh, L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 6, 1337-1347(Jun 1973). (In Russian).

The most general complete set of commuting operators on the sphere in three-dimensional complex space is demonstrated. It is shown that this set of diagonal operators is realized for the most general parametrization of the sphere in this space. The wave eigenfunctions of this set of operators are constructed. These functions represent the elliptical basis for the irreducible SU(3)-group representations. Not a single spin is conserved separately in such representations on SU(2)-subgroups of the SU(3) group. (auth)

23300 THEORETICAL PHYSICS. An Advanced Text. Volume 3. Quantum Mechanics. Levich, B. G.; Myamlin, V. A.; Vdovin, Yu. A. New York; John Wiley and Sons, Inc. (1973). 639p.

Translation of Kurs Teoreticheskoi Fiziki by S. Subotic.

The topics covered are the basic concepts of quantum mechanics, the Schroedinger equation, the mathematical apparatus of quantum mechanics, motion in a centrally symmetric field, the quasi-classical approximation, matrix form of quantum mechanics, perturbation theory, and spin and identity of particles. Also discussed are applications of quantum mechanics to atomic and nuclear systems, the theory of diatomic molecules, scattering theory, the method of second quantization and radiation theory, relativistic quantum mechanics, some problems of quantum electrodynamics, and fundamentals of the theory of elementary particles. (JFP)

23301 ALLOWANCE FOR THE EFFECT OF ELECTRONIC-NUCLEAR INTERACTION IN THE THEORY OF MOLECULAR VIBRATIONAL-ROTATIONAL SPECTRA. Bolonkin, A. E. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 5, 465-468(Nov 1972).

Translated from Opt. Spektrosk.; 33: No. 5, 844-849(Nov 1972).

The solution of the complete Schrödinger equation is discussed, taking electronic-nuclear interaction (ENI) and the correlation energy of the electrons into account. Allowance for the correlation terms in the electronic problem leads to a dependence of the electronic energy on the nuclear masses. Up to and including the third order, the total energy can be divided into an electronic part and a nuclear part. Even in the first order, the complete function cannot be represented in the form of a product of electronic and nuclear functions. ENI leads to the appearance of centrifugal and complex Coriolis corrections in the nth order of the effective operator for the energy of nuclear motion. The matrix elements of the inverse inertia tensor depend on the Coriolis interaction and the correlation terms. On account of ENI, the inertia tensor is not diagonal at the equilibrium configuration of the nuclei. The form of the vibrational-rotational energy operator in the ground electronic state will change only when the correlation terms are taken into account. For a diatomic molecule, hyperfine splitting of the rotational levels is possible in a II state. (auth)

23302 QUANTIZATION IN GENERALIZED COORDINATES. 3. Lagrangian Formulation. Gruber, G. R. (Hofstra Coll., Hempstead, NY). Int. J. Theor. Phys.; 7: No. 4, 253-257(1973).

It is shown that if one incorporates the generalized coordinate quantum velocities $\dot{q}^i$ as given by $\dot{q}^i = i[H,q^i]$ ($h = 1$) into the generalized classical Lagrangian for a free particle (the total energy), $L = \frac{1}{2}\dot{q}^i g_{ik} \dot{q}^k$, one does not obtain (no matter what ordering of the

operators $\dot{q}^i$, q^k, and g_{ik} are chosen) the correct quantum Lagrangian operator which is a transformation from $-\frac{1}{2}\nabla^2$ to generalized coordinates (Gruber, Foundation of Physics; 1: 3, 227 (1971) and Int. J. Theor. Phys.; 6: 1, 31 (1972)). $\dot{q}^i$ as given by $\dot{q}^i = i[H,q^i]$ turns out to be the Hermitian part of a more generalized operator which can be called the total generalized velocity operator similar to the notation in previous articles (Gruber, 1971, 1972). This total velocity operator really determines the fundamental structure governing the system in the Lagrangian formulation. It is shown that it is through the total velocity operator that the transition from classical to quantum mechanics is made and through this procedure the correct quantum Lagrangian operator is arrived at. (auth)

23303 NOMOGRAPHIC METHODS FOR THE DETERMINATION OF THE PARAMETERS FOR FUNCTIONAL RELATIONS FROM EXPERIMENTAL DATA. Potetyunko, G. N. At. Energ. (USSR); 33: No. 2, 698-699(Aug 1972). (In Russian).

This paper was summarized as paper No. 600/6696 with full copy held by TIC.

The use of nomographic methods for determining parameters for functions of two or more variables from experimental data is discussed. The determination of the parameters of the Breit–Wigner formula for the ^{115}In(p,n) reaction is illustrated. (JWR)

23304 EINSTEIN–PODOLSKY–ROSEN PARADOX. Mirman, R. (Long Island Univ., Brooklyn). Nuovo Cim.; 16B: No. 2, 398-403(11 Aug 1973).

A standard experiment is studied to see whether the Einstein–Podolsky–Rosen paradox leads to any difficulty in physically understanding the predictions of quantum mechanics. The role played by the measuring apparatus is stressed. It is found that there is no problem in understanding the results given by ordinary quantum mechanics. (auth)

23305 STATE AUTOMORPHISMS IN AXIOMATIC QUANTUM MECHANICS. Gudder, S. (Univ. of Denver). Int. J. Theor. Phys.; 7: No. 3, 205-211(Apr 1973).

A new metric, the "intrinsic metric", is introduced on the states L of the generalized logic of quantum mechanics. It is shown that every automorphism on L is an isometry. A norm can be defined on the linear span E of L which reduces to the intrinsic metric on L. If X is the completion of E then every automorphism on L has a unique extension to a linear isometry on X. A comparison is made between these results and those of N. Kronfli (Int. J. Theor. Phys.; 2: No. 4, 345 (1969) and 3: No. 3, 191 (1970)). (auth)

Quantum Field Theories

Refer also to abstracts 22500, 22501, 22540, 22562, 22570, 22571, 22651, 22652, 23337, 23343, and 23637.

23306 (FRNC-R-20, pp II.87-II.104) STRUCTURE OF THE PHENOMENOLOGICAL APPROACH TO THE ADLER ANOMALY. Biedenharn, L. C. (Univ., Karlsruhe, Ger.). 1972.

It is shown that the phenomenological approach to the Adler anomaly may be re-formulated as the problem of determining 1-forms for a given gauge group. Some preliminary results in this problem are presented. (auth)

23307 (ITF-73-33-P) INTERACTION $(\lambda\bar{\Psi}\Psi\Phi^n + g\Phi^{2n})_{1+1}$; $n \geq 2$: LEE TYPE MODEL. Zolotaryuk, A. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 22p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

The renormalized Hamiltonian and the wave operators without cut-offs are constructed for a generalized Lee type model. It is proved that the Hamiltonian is a self-adjoint and bounded from below operator in each sector. (auth)

23308 (JEN-252) TACHYONS. Velarde, G. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 29p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.50.

The properties of tachyons and the experimental methods to detect them are studied. The principle of causality is analyzed. (tr-auth)

23309 (JINR-E2-7320) ULTRAVIOLET BEHAVIOR OF SPONTANEOUSLY BROKEN GAUGE THEORIES. Belokurov, V. V.; Kazakov, D. I.; Shirkov, D. V.; Slavnov, A. A.; Vladimirov, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The asymptotic invariant coupling constant (ICC) in the repulsive σ^4 interaction is shown to be finite in the second logarithmic approximation. It leads to spontaneously broken gauge theories free of ultraviolet (uv) troubles. (auth)

23310 (ORO-3992-83) FUNDAMENTAL LENGTHS IN THE DISPERSION RELATION FOR LIGHT. Ugaz, E. (Texas Univ., Austin. Center for Particle Theory). Jun 1973. 13p. (CPT-137). Dep. NTIS $3.00.

In connection with Rawls' test of a modified dispersion relation for light using pulsar data, it is found that, under some very general restrictions, all noncovariant generalizations of Maxwell's wave equation can be written down. They provide a framework for the study of any possible noncovariant term in the dispersion relation for light. The results either rule out the equations or place an upper limit on all such terms by considerations not involving extraterrestrial measurements. (auth)

23311 (ORO-3992-129) GAUGE SYMMETRIES IN NON-LINEAR SPINOR THEORIES. Duerr, H. P. (Texas Univ., Austin. Center for Particle Theory). Jul 1973. 42p. (CPT-177). Dep. NTIS $4.25.

In order to obtain quantum electrodynamics from a general field theory phase gauge invariance for such a theory is required without the artifice of introducing an additional vector field. A two-component Weyl spinor field is considered as a source field. (JFP)

23312 (ORO-3992-130) PROBLEM OF UNITARIZATION IN FIELD THEORIES WITH INDEFINITE METRIC. Duerr, H. P. (Texas Univ., Austin. Center for Particle Theory). 1973. 31p. (CPT-179). Dep. NTIS $3.75.

Lectures are given on theories in which the indefinite metric and the unitarization are more closely connected with the particular dynamics. As examples quantum electrodynamics, the Heisenberg Lee model, and the massless quantum field theories of higher spin or with interior degrees of freedom (massless Yang–Mills theories) are given. It is found that all these theories have a particular ghost structure which may or does enable their unitarization. (JFP)

23313 (ORO-3992-132) UNITARITY IN GAUGE THEORIES WITH NONLINEAR GAUGE CONDITIONS. Hsu, J. P. (Texas Univ., Austin. Center for Particle Theory). Jun 1973. 16p. (CPT-181). Dep. NTIS $3.00.

The Abelian gauge theories in which the transverse and the longitudinal photons are coupled are considered. The unitarity relation holds because the unwanted absorptive part of the amplitude due to this coupling is cancelled by the fictitious particle. It is pointed out that, by introducing the Lagrange multiplier, one can see the cancellations for all orders in perturbation expansions by looking at the equation of motion for the Lagrange multiplier. The possible implication of this on the massless Yang–Mills fields is indicated. (auth)

23314 INTERACTION INTERPRETATION OF SPECIAL RELATIVITY THEORY. Part II. Schlegel, R. (Michigan State Univ., East Lansing). Found. Phys.; 3: No. 3, 277-295(Sep 1973).

The interaction interpretation of special relativity theory is discussed in relation to quantum theory. The relativistic transformations (Lorentz processes) of physical variables, on the interaction interpretation, are observation-interaction dependent, just as are the physical values (eigenvalues) of systems described by quantum-theoretic state functions; a common, basic structure of the special relativity and quantum theories can therefore be presented. The constancy of the light speed is shown to follow from interaction-transformations of frequency and wave length variables. A parallelism is suggested between, on the one hand, the Lorentz–Clausius distinction for relativistic transformations, and, on the other, the distinction between observation-dependent and observation-independent natural processes. The empirical study of rates of macroscopic clocks can provide a critical test of the interaction interpretation and of a possible extension to gravitational time changes; the role of time as prior determinant of natural process is at issue. The Hafele–Keating observations are of general relativity effects on clocks in accelerated motion. (auth)

23315 FORMAL SERIES EXPANSION FOR THE SOLUTION OF FIELD EQUATIONS FOR FREE PARTICLES HAVING SPINS OF $\frac{3}{2}$ AND $\frac{1}{2}$ IN A CURVED DE SITTER SPACE TIME. Claire, R. (Clermont-Ferrand Univ., Aubiere, France). Compt. Rend., Ser. A, B; 276: No. 19, 1321-1324(9 May 1973). (In French).

The Klein–Gordon equation is studied together with the spectrum of the Casimir operators, C_1 and C_2, of the SO(1,4) group for free particles having $\frac{3}{2}$ spin. The spin operator, the expression for C_1, and the Klein–Gordon equation in a particular coordinate system are determined. A formal series expansion is obtained for the solution of this equation and the Dirac equation in a de Sitter space. (auth)

23316 QUANTUM-MECHANICAL BEHAVIOR OF A PARTICLE WITH RESPECT TO A UNIFORMLY ROTATING SYSTEM OF REFERENCE IN SPECIAL RELATIVITY. Venini, C. Atti Accad.

Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 52: No. 5, 720-725 (May 1972). (In Italian).

Within the terms of relativistic quantum mechanics the behavior of a material particle in a uniformly rotating system of reference is determined. The particle is likely to be found in the region that, on the contrary, is unreached according to the usual theory of relativity. The previous result is in conformity with the Heisenberg uncertainty principle. (auth)

23317 THERMODYNAMIC LIMITS IN MODELS OF QUANTUM FIELD THEORY. Petrina, D. Ya.; Ivanov, S. S. (Inst. of Theoretical Physics, Kiev). Dokl. Akad. Nauk SSSR; 210: No. 1, 59-61 (1 May 1973). (In Russian).

A theorem concerning thermodynamic limits was proposed with regard to the model of a scalar field derived from a Lagrangian. An expression was derived which had a direct analogy with an equilibrium static system. The given result was shown to be transposable to a Green function, and conversely. (KSW)

23318 RELATIVISTIC SCHROEDINGER EQUATION FOR A PARTICLE WITH ARBITRARY SPIN. II. Ionescu-Pallas, N. J. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 4, 419-436(1973).

The relativistic Schroedinger equation formerly derived is now generalized in order to include simultaneously vectorial, scalar, pseudovectorial and pseudoscalar interactions, without leaving the irreducible (2S + 1) representation. For this purpose, a new approach to the theory, which deals with bilinear forms and Lagrange function is adopted. Poincaré algebra and, consequently, the classical integrals of motion may be easily obtained by going over to the 2 (2S + 1) dimensionality. The possibility of nonlinear extension of the wave equation is investigated as well. Finally, it is pointed out that relativistic and probabilistic quantum mechanics for a particle with arbitrary spin would be possible without using redundant components, if the gyromagnetic ratio g is assumed g = 2, irrespective of spin and interaction. (auth)

23319 INEXACTNESS OF TIME. Miller, G. (Univ. of Victoria, B. C.). Found. Phys.; No. 3, 389-398(Sep 1973).

The differential aging effect is shown to be valid in any physically reasonable extension of the special theory of relativity which includes a description of accelerating observers. Einstein's controversial assumption—the clock hypothesis—is avoided. Instead, it is sufficient to assume accessibility—that it is possible to travel from one inertial observer to another and then return to the first in a reasonable manner. Since Minkowski-space–time displays this accessibility property, there must be an error in Sach's quaternion development of general relativity. No assumptions concerning measurements—proper time—of accelerating observers are necessary, nor are assumptions concerning special features of their motion—uniform acceleration. (auth)

23320 ELECTROVAC FIELDS WITH GEODESIC EIGENRAYS. Lukacs, B.; Perjes, Z. (Magyar Tudomanyos Akademie Kozponti Fizikai Kutato Intezete, Budapest). Gen. Relativity Gravitation; 4: No. 2, 161-172(1973).

The stationary states of electrovac fields for which the geodesic eigenrays of both the Maxwell and gravitational field coincide are investigated. The fact that the Kerr-Newman solutions belong to this class lends physical interest to the fields considered here. Particular attention is devoted to fields with shearing eigenrays since principal null congruences do not coincide with eigenrays in this case, and so earlier approaches to the problem fail. By the generalization of a theorem on the corresponding vacuum case, it is proven that no "spherical" solutions exist in the shearing class, with the exception of the fields with $\gamma^2 \equiv |G_0|^2 - |H_0|^2 = 0$. The metrics with $\gamma = 0$, admitted by the theorem, can either be calculated from the corresponding vacuum solutions by a relatively simple procedure, or, if not, they are explicitly listed. (auth)

23321 FREELY FALLING CLOCKS. Armstrong, H. L.; Fremlin, J. H.; Jacob, R.; Whippman, M.; Stedman, G. E. (Queen's Univ., Kingston, Ont.). Nature (London); 244: No. 5410, 26-27(6 Jul 1973).

Comments are offered on Dingle's questions (Nature 242: 423 (1973)) regarding freely falling clocks in the following series of communications: "Freely falling clocks"—H. L. Armstrong, "In defence of Dingle's opponents"—J. H. Fremlin, "Another answer to Dingle's question"—R. Jacob, "Whippman's answer"—M. Whippman, "Stedman's answer"—G. E. Stedman. (UK)

23322 COMMENTS ON THE CLOCK PARADOX. Sachs, M. (State Univ. of New York, Buffalo). Int. J. Theor. Phys.; 7: No. 4, 281-285(1973).

Comments are made on a paper by Wu and Lee (Int. J. Theor. Phys.; 5: 5, 307(1972)) in which they claimed to carry out an exact calculation of the comparison of total proper times of two systems that are initially in the same inertial frame, one then making a set of changes from this frame to take a round-trip journey, eventually returning to the frame of the other. Their conclusion, which agrees with the claim of the majority, is that a twin who takes the trip will return having aged less than his brother, and that both twins will agree on the precise quantity of age retardation of the traveller, relative to the "stay-at-home" brother. It is not believed that they have in fact carried out an exact, nor an unambiguous treatment of this problem, nor that their conclusions are justified, even in an approximate sense. Their method of analysis is perhaps applicable to some problems in special relativity theory, but not so to the clock problem, which it is contended must necessarily entail an incorporation of non-uniform motion in the proper way, according to general relativity theory as a crucial ingredient. (UK)

23323 FURTHER STUDIES IN AESTHETIC FIELD THEORY; EXISTENCE OF A BOUNDED PARTICLE. Muraskin, M. (Univ. of North Dakota, Grand Forks). Int. J. Theor. Phys.; 7: No. 3, 213-228(Apr 1973).

Various possibilities were considered within aesthetic field theory, with particular attention to the case of g = 0. The g = 0 situation could be associated with the introduction of Newtonian absolute time into aesthetic field theory. It could be argued that Lorentz invariant boundary conditions for the universe are unlikely, giving impetus to the study of g = 0. It was found that the field equations had to be modified from the form that they take when g = 0. Also, an infinite number of integrability equations had to be satisfied. It was necessary that the data had an underlying structure that was invariant under $0'(3) \times T$. This set of data appeared satisfactory with respect to integrability and gave rise to a minimum in g_{00} at the origin. After a long computer run along the coordinate axes, a bound was found on the particle-like object. This is the first time such a result was obtained. (auth)

23324 AXIOMS OF OBSERVABLE ALGEBRA AND THE NOTION OF FIELD. Polivanov, M. K.; Sushko, V. N.; Khoruzhii, S. S. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 16: No. 1, 3-20(Jul 1973). (In Russian).

Recent development of the algebraic axiomatic approach in quantum field theory is briefly reviewed. The main subjects considered are the rigorous algebraic treatment of systems with superselection rules and the procedure (worked out by Doplicher, Haag and Roberts) of constructing field quantities starting from the observable algebra. (auth)

23325 EXAMPLE OF SELF-LOCALIZING NONLINEAR RELATIVISTIC FIELD. Davydov, A. S.; Kislukha, N. I. (Inst. of Theoretical Physics, Kiev). Teor. Mat. Fiz.; 16: No. 1, 100-104(Jul 1973). (In Russian).

The scalar neutral relativistic field with the self-interaction term $\lambda\varphi^4/4$ in the Lagrangian is studied. The exact solution is obtained in the one and three-dimensional cases. It is shown that in the one-dimensional case the field is localized in some region, the size of which changes under the Lorentz transformation. The energy and momentum of the field are proportional to the inverse coupling constant, and there is a relativistic connection between them, which is the same as in the case of a particle with internal energy. In the three-dimensional case the field is localized in one dimension only. (auth)

23326 APPLICATION OF MERCER'S THEOREM IN FIELD THEORY. Benard, C. (Paris Univ., Orsay, France). Nuovo Cim.; 16B: No. 2, 355-375(11 Aug 1973).

The states of boson or fermion fields, localized in a finite volume V, are characterized by the mean values of the field operator products. The states that are considered here are normal and such that these mean values are Gaussian (boson) or anti-Gaussian (fermion) and invariant by an arbitrary change-of-phase origin. They are said to belong to C. For the states of C, a canonical form of the density operator is explicitly given by use of Mercer's theorem. This canonical form is shown to be chaotic if the mean values are totally translationally invariant and pseudochaotic otherwise. Moreover the locally normal gauge-invariant quasi-free states of infinite systems are shown to be the limit of C when V goes to infinity. As a consequence, the quantum boson characteristic functional associated with such a quasi-free state can be considered as the limit when V goes to infinity of the boson probabilistic characteristic functional associated with a (pseudo-) chaotic state. Hence, this quantum boson characteristic functional provides a probabilistic description of (pseudo-) chaotic states when V goes to infinity. (auth)

23327 VAIDYA'S METRIC FOR A TACHYON FIELD. Banerjee, A. (Jadavpur Univ., Calcutta). Curr. Sci. (India); 42: No. 14, 493-494(20 Jul 1973).

A static axially symmetric exact solution of the Einstein equa-

tion $R_{ik} = 0$ was recently obtained which was interpreted as describing the gravitational field of a tachyon. It is pointed out that the discussion of the gravitational field does not clearly define the region of validity of the relevant metric and some of the conclusions need correction. An attempt to give a correct analysis regarding the region of validity is made. The conclusions are different at some points from the previous ones. (JFP)

23328 NEW VARIATIONAL METHOD FOR THE NONSYMMETRIC UNIFIED FIELD THEORY. Tautz, M. F. (Northeastern Univ., Boston). Nuovo Cim.; 16B: No. 2, 311-323(11 Aug 1973).

A new variational procedure, which is a natural extension of the Palatini method, is presented and then used to derive systems of transposition-invariant field equations. Included as special cases are Einstein's relativistic theory of the nonsymmetric field (in its normalized forms), Schrödinger's affine-field laws and Kursunoglu's theory. (auth)

23329 CONNECTION BETWEEN THE QUANTUM PROPAGATORS AND THE GEOMETRICAL PARALLEL DISPLACEMENT. Vilkovyskii, G. A. Teor. Mat. Fiz.; 16: No. 1, 90-99 (Jul 1973). (In Russian).

By means of the parallel displacement operation continual representation of the Green functions of tensor and spinor wave equations in the external gravitational and Yang–Mills fields is obtained. A functional is obtained, which corresponds to covariant derivative operator for tensors of arbitrary rank. (auth)

23330 A COUPLED THEORY OF ELECTROMAGNETISM AND GRAVITATION. Linden, T. L. J. (European Space Research Organisation, Darmstadt, Ger.). Int. J. Theor. Phys.; 7: No. 3, 159-168(Apr 1973).

A coupling of electromagnetism with a previously developed scalar theory of gravitation is presented. The principle features of this coupling are: a slight alteration to the Maxwell equations, the motion of a charged particle satisfies an equation with the Lorentz force appearing on the right side in place of zero, and the energy density of the electromagnetic field appears in the gravitational field equation in a manner similar to the mass term in the Klein–Gordon equation. The field of a static, spherically symmetric charged particle is computed. The electromagnetic field gives rise to $1/r^2$ terms in the gravitational potential. (auth)

23331 LAGRANGIAN FIELD THEORY. Stora, R. (CNRS, Marseille). pp 1-79 of Particle Physics. DeWitt, C. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

A review is given of a number of well-known topics in relativistic quantum field theory. The first section introduces the topics and gives a general bibliography. Section II reviews the phenomenological description of particles as a consequence of relativistic invariance and of their interactions through the definition of a scattering operator. Some relevant results of general field theory are then recalled, with due emphasis on collision theory and on the properties of free fields. Section III introduces the concept of an interaction Lagrangian according to Bogoliubov, and the general framework is set up for the construction of the corresponding perturbation series as a formal power series in terms of smooth, space time dependent coupling constants. Section IV deals with the theory of power counting, the counterterm philosophy, and the theory of Green's functions emerging from the adiabatic limit in which the space time dependence of some of the coupling constants is removed. Section V is devoted to canonical theories with emphasis on the study of exact or approximate symmetry laws and their implementation by means of Ward identities. (LBS)

23332 IMPOSSIBILITY OF THE FIRST-ORDER RELATIVITY TEST. Tyapkin, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett, Nuovo Cim.; 7: No. 15, 760-764(11 Aug 1973).

Errors in previous tests of relativity theory are pointed out. It is noted that in contrast to the experiments on the Doppler shift which may be given a correct treatment as test additionally confirming second-order relativistic effects, the experiment on the measurements of the phase shift of oscillation coming from two sources cannot be in general reasonably substantiated. (JFP)

Gravitation and General Relativity

Refer also to abstracts 22532, 22580, 22581, 22621, 23315, 23320, 23328, 23329, and 23330.

23333 (IC-73/95) GRAVITATIONAL RADIATION AND GENERAL RELATIVITY. Sciama, D. W. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The basic properties of gravitational radiation, as predicted by general relativity, are described and compared with those of electromagnetic radiation. Some recent results on radiative processes in the vicinity of black holes are outlined. It is stressed that some of these processes lead to more efficient methods of converting rest mass into radiative energy than any other known except matter-antimatter annihilation. Since one would expect there to be a large number of black holes in the universe, these conversion processes may be important in astronomy. Research into gravitational radiation, both theoretical and observational, should therefore be conducted vigorously. (auth)

23334 (JINR-P2-7230) POINT SOURCE OF MASSIVE SCALAR FIELD IN GENERAL RELATIVITY. Asanov, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

As a result of previous work it follows, that the black hole has no scalar field outside it. The proofs are given under assumptions that a horizon does exist, the field is bounded on the horizon and outside it and the scalar field influences weakly the metric. So, the complete solution of the problem seems to be absent today. It is noted that the scalar field influence on the metric can be rather essential. For instance, some static solutions where the scalar field is present do not possess the horizon. This is the exact solution for point source of massless scalar field, where the simplest generalization of Klein equation is used. Just the same property has the particular numerical solution for the point source of electrostatic and massless scalar fields, which was found under conditions $\kappa\epsilon^2 = 1.1\kappa^2m^2$; $\kappa G^2 = 0.1\kappa^2m^2$ (here κ is the gravitational constant, ϵ-electric charge, G-scalar constant, m-the total mass of the system, $\hbar = c = 1$). Based on this solution an equilibrium model of a body with dust-like matter was constructed the radius of which ($R \sim 0.9\ \kappa m/C^2$) is less than dimensions of the horizon ordinary considered, and no singularity occurs. Some more examples of the solution without horizon are given. It is a numerical static solution to a point source of the massive scalar field. The ordinary scalar and parameter values are used. The results are presented. (auth)

23335 EINSTEIN–CARTAN EQUATIONS. IV. Trautman, A. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 4, 345-346(1973).

It is shown that with every one-parameter group of symmetries of a Riemann–Cartan space-time there is associated a conservation law dj = 0 for the current of energy, momentum and/or spin. (auth)

23336 NON-LORENTZIAN TRANSFORMATION OF A FRAME OF REFERENCE. Rodichev, V. I.; Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5: 104-112(1973). (In Russian).

The structure of the transformation describing the transition from an inertial frame of reference to a noninertial and reverse frame of reference was investigated. As a result of such a transition the space-time curvature was altered which makes it possible to indicate its observable character. This leads to a new interpretation of the general relativity theory in which at present the space curvature is connected only with noninertial motion of the observer. As an illustration the transition from noninertial frame of references, corresponding to Schwarzschild space, to an inertial frame of reference (two-dimensional space) is discussed. (tr-auth)

23337 ELECTROMAGNETIC INVESTIGATION IN THE GENERAL RELATIVITY THEORY. II. Maximum General Point Solution of the Einstein and Maxwell Equations at $\omega = 0$ and Theta = 1/r. Razgovorov, N. N. (Magadan State Teacher's Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 32-35(1973). (In Russian).

Spaces, assuming normal shiftless expanding congruence of the isotropic geodesic, were examined. The metric form was obtained explicitly in which a common solution of the Einstein and Maxwell equations was possible for isotropic electromagnetic fields. (tr-auth)

23338 DYNAMICS OF GRAVITATIONAL FIELDS. I. Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz., No. 5, 97-103(1973). (In Russian).

The dynamic theory of gravitational fields was constructed in analogy with the theory of electromagnetic fields in two-dimensional space. The determination in Einstein space of the analog of the inertial and quasiinertial frame of reference in two-dimensional space seemed the principal point of the study. The possibility was discussed of the interpretation of field with base velocity both as a frame of reference and potentials of gravitational fields. This makes it possible to construct a theory of gravitational fields (field equations and energy characteristics) in the Maxwell form. (tr-auth)

23339 CONFORM TRANSFORMATIONS IN SPACE–TIME. Mavrychev, Yu. S. (Ivanovo Energy Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 5, 125-126(1973). (In Russian).

As is known the restrictions of transformation conformity on complex surfaces coincide with the restrictions of existence of derived surfaces and with restrictions of independence of contour integrals from the trajectory. The purpose of the present study is to show that for space-time coincidence of this kind does not take place. (JSR)

23340 ENLIGHTENING OF CURVED SPACE PHYSICAL CONCEPTION. Hafner, H. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 4, 467-482(1973).

Some arguments are brought certifying the necessity of the introduction of curved space–time, and strongly pointing out the fact that the curved 4-dimensional space is required by the physical phenomena. Likewise, the conclusion is reached that the light propagation through a region in which there is a gravitational field is equivalent to the coming across of a refringent (dielectric) medium, according to a relation extended to an arbitrary field configuration. At the same time, taking into account that gravitation exhibits only attraction, the impossibility of surpassing the light velocity in empty space even in the presence of the gravitational field is concluded. Finally, the Schwarzschild metrics which is not rigorously Lorentz invariant owing to the discarding of the small terms due to source recoil, is brought to a full invariance by accounting for the respective terms and by resorting to a matrix formalism which allows a convenient covariant generalization. As an outstanding conclusion, the major role played by Einstein's theory of gravitation is pointed out, either for the entering upon of local phenomena (at the scale of solar system) or for the study of cosmology. (auth)

23341 NONRADIATIVE MOTION IN A RADIATIVE GRAVITATIONAL FIELD. Yadav, B. P. (Physical Research Lab., Ahmedabad, India). Lett. Nuovo Cim.; 7: No. 15, 697-700 (11 Aug 1973).

A gravitational field is discovered which allows a nonradiative motion solution during its radiative period, that is, this field has the dual property of being radiative and nonradiative simultaneously over the same interval and contains a quadrupole moment and all other higher moments, but does not possess mass and dipole moment. The spin coefficient approach is used. (JFP)

23342 QUANTIZED SPINOR FIELD IN THE CONSTANT CURVATURE SPACE–TIME. Levitskii, B. A. Vestn. Leningrad. Univ., Geol., Geogr.; No. 1, 7-15(Feb 1973). (In Russian).

The quantization of a spinor field in the constant curvature space–time was effected. The limit to quantized field in the flat world is considered. (auth)

23343 SYNTHESIS OF GRAVITATION AND ELECTROMAGNETISM IN A NEW UNIFIED FIELD THEORY. Ghosh, N. N. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 47: No. 3, 187-188(Mar 1973).

The unified field equations in vacuum are found from a set of 80 symmetric connection coefficients restricted by 16 conditions. (JFP)

23344 PERSPECTIVES ON THE SCHWARZSCHILD SINGULARITY. Cooperstock, F. I.; Junevicus, G. J. G. (Univ. of Victoria, British Columbia). Nuovo Cim.; 16B: No. 2, 387-397 (11 Aug 1973).

A survey and discussion of some of the literature pertaining to the Schwarzschild singularity is presented. Scalar indeterminacies, with particular reference to the metric of Bach and Weyl, are cited as evidence for the reality of the Schwarzschild singularity. An analogy is drawn with the work of Janis, Newman and Winicour. (auth)

23345 DEFINITION OF MULTIPLE MOMENTS FOR EXTENDED BODIES. Dixon, W. G. (Cambridge Univ., Eng.). Gen. Relativity Gravitation; 4: No. 3, 199-209(Jun 1973).

From international conference on gravitation and relativity; Copenhagen, Denmark (Jul 1971).

There is considerable freedom in the definition of multipole moments of the energy-momentum tensor of an extended body in general relativity. By studying the corresponding Newtonian theory guidelines are obtained which enable one to choose the most suitable definitions in the relativistic theory. In this way two sets are found, the complete moments and the reduced moments, of which the latter are the most natural choice for studying the dynamics of extended bodies. Expressions as explicit integrals are given for both sets, and the multipole equations of motion of the body are given in a form exact to all orders. (auth)

23346 HARMONIC OSCILLATIONS OF ELASTIC CONTINUA AND DETECTION OF GRAVITATIONAL WAVES. Maugin, G. A. (Univ., Paris). Gen. Relativity Gravitation; 4: No. 3, 241-272 (Jun 1973).

It is shown that the equation derived by Weber (General Relativity and Gravitational Waves (1961)) from the equation of geodesic deviation–the equation that constitutes the basis for the theoretical studies concerning the detection of gravitational waves–can be obtained as an approximation to an equation deduced from Cauchy's equation which governs an elastic continuum. This is achieved within the frame of the formalism of the theory of relativistic continua developed by A. C. Eringen and his collaborators and the present author. The use of piezoelectric crystals in order to measure the stresses that result from incident gravitational waves is also examined within the framework provided by this theory. (auth)

23347 LINEAR THEORY OF GRAVITATION IN THE RADIATION GAUGE. Campbell, W. B. (Univ. of Nebraska, Lincoln). Gen. Relativity Gravitation; 4: No. 2, 137-147(1973).

A global gauge for the linear theory of gravity is given which avoids the (ln(R))/R problem of harmonic coordinates. Consequently it is possible to do 1/R expansions for precisely those null sources which lead to difficulties in the harmonic gauge. This is important, for example, in second order calculations where the first order field is a gravitational wave. This gauge makes manifest the two degrees of freedom for the dynamic fields. In it the second time derivative of the metric itself has physical significance since $R_{0l0j} = -\frac{1}{2}\bar{h}_{ij}$. (auth)

23348 SHEAR FREE NORMAL FLOWS OF A PERFECT FLUID. Barnes, A. (Imperial Coll. of Science and Tech., London). Gen. Relativity Gravitation; 4: No. 2, 105-129(1973).

Flows of a perfect fluid in which the flow-lines form a time-like shear-free normal congruence are investigated. The space–time is quite severely restricted by this condition on the flow: it must be of Petrov Type I and is either static or degenerate. All the degenerate fields are classified and the field equations solved completely, except in one class where one ordinary differential equation remains to be solved. This class contains the spherically symmetric nonuniform density fields and their analogs with planar or hyperbolic symmetry. The type D fields admit at least a one-parameter group of local isometries with space-like trajectories. All vacuum fields which admit a time-like shear-free normal congruence are shown to be static. Finally, shear-free perfect fluid flows which possess spherical or a related symmetry are considered, and all uniform density solutions and a few nonuniform density solutions are found. The exact solutions are tabulated. (auth)

23349 ONE NEW EFFECT OF THE EINSTEINIAN THEORY OF GRAVITATION. Shirokov, M. F. (Moscow Aviation Inst.). Gen. Relativity Gravitation; 4: No. 2, 131-136(1973).

It is shown by using the equation of geodesic deviation that a small test particle, placed in the center of inertia of a terrestrial spherical satellite, will vibrate if a small initial momentum $d\xi^i/ds$ be given to this particle at a certain moment of the satellite's proper time s = 0. These vibrations may be in the satellite's orbital plane and the plane perpendicular to it. The difference between the periods of these vibrations is one new effect of the Einsteinian theory of gravitation (GTR). The shifting of the point of intersection on the lines of these vibrations corresponds to this difference of periods. This shifting, taking place in the time of several complete periods, will be of a distance 10^{-6} to 10^{-7} cm if plausible assumptions about the quantities of the test particle velocities and amplitudes are made. (auth)

23350 ALGEBRAIC RAINICH CONDITIONS. Lovelock, D. (Univ. of Waterloo, Ont.). Gen. Relativity Gravitation; 4: No. 2, 149-159(1973).

It is well known that the Einstein–Maxwell field equations are the Euler–Lagrange equations associated with a particular Lagrange density. It is also well known that, in a four-dimensional space, the Einstein–Maxwell field equations give rise to the Rainich conditions (which can be divided into two types, the algebraic and the differential Rainich conditions). It is shown that the algebraic Rainich conditions are inevitably the consequence of every Euler-Lagrange equation associated with each member of a special class of Lagrange densities. However, in general, these Euler-Lagrange equations are not the Einstein–Maxwell field equations, although the Lagrange density associated with the latter is a particular member of this class. (auth)

23351 CLASSIFICATION OF THE SPACE–TIME CURVATURE TENSOR, RESTRICTED CASE. Mishra, R. S. (Banaras Hindu Univ., India). Gen. Relativity Gravitation; 4: No. 3, 225-240(Jun 1973).

From international conference on gravitation and relativity; Copenhagen, Denmark (Jul 1971).

Einstein field equations are assumed in a certain restricted form. The problem to be solved consists, roughly, of the enumeration of all curvature tensors which satisfy these equations. (auth)

23352 CONFORMALLY FLAT SPACE–TIME OF SPHERICAL SYMMETRY IN ISOTROPIC COORDINATES. Kuchowicz, B. (Univ., Warsaw). Int. J. Theor. Phys.; 7: No. 4, 259-262(1973).

When spherically symmetric distributions of noncharged, perfect fluid in general relativity are studied, a general expression giving the metric can be obtained under the assumption that the space–time is conformally flat. Formulas for the metric, energy density and pressure are given in isotropic coordinates. (auth)

23353 ADJOINT SOLUTIONS OF THE BRANS–DICKE EQUATIONS. Buchdahl, H. A. (Australian National Univ., Canberra). Int. J. Theor. Phys.; 7: No. 4, 287-289(1973).

It is shown that if the Brans–Dicke equations have the solution ϕ, g_{ij} generated by the trace-free source T_{kl} ($T = 0$) then there exists an "adjoint solution" ϕ^{-1}, $\phi^2 g_{ij}$ of these equations generated by the source $\phi^{-2}T_{kl}$. An example is considered. (auth)

23354 QUADRATIC LAGRANGIANS AND STATIC GRAVITATIONAL FIELDS. Buchdahl, H. A. (Australian National Univ., Canberra). Proc. Cambridge Phil. Soc.; 74: No. 1, 145-148 (Jul 1973).

It is shown that the solutions of the field equations generated by the most general effective quadratic Lagrangian $aR^2 + bR_{kl}R^{kl}$ which are static, singularity-free, of class C^4 and asymptotically flat (of rank A^3) are conformally flat when $3a + b = 0$, flat when $3a + b \neq 0 (b \neq 0)$, and have zero scalar curvature when $b = 0$. (auth)

REACTOR TECHNOLOGY AND REGULATION

23355 (AED-CONF-72-12-3) PUBLIC PROMOTION OF REACTOR DEVELOPMENT IN THE FEDERAL REPUBLIC OF GERMANY. Kempken, M. (Bundesministerium fuer Bildung und Wissenschaft, Bonn (West Germany)). 1972. 13p. (In German). (CONF-720220-1). INIS.

From specialist meeting on nuclear technology; Frankfurt/Main, Federal Republic of Germany (22 Feb 1972).

A description is given of the role of state, industry and electric utility companies in reactor development in the past as well as in the present. The 3rd Atomic Program of the Federal Republic of Germany is outlined as a basis for future projects which are briefly described. (INIS)

23356 OPERATING EXPERIENCE OF GERMAN NUCLEAR POWER STATIONS IN 1972. Atomwirt., Atomtech.; 18: No. 7, 355-363(1973). (In German).

The first two commercial nuclear power stations in the German Federal Republic, KKS Stade and KWW Wuergassen, both of which belong to the 600 MW category were commissioned in 1972. Even though in neither case was the transition to full operation without troubles, power generation from nuclear energy increased by about 50% to 9,512 GWh as compared with 1971. Various troubles with long shutdowns diminished the average time availability of all nuclear stations to about 56.5%. None of the troubles prejudiced the safety of the plants. (GE)

23357 ITALY'S NUCLEAR ACTIVITY IN 1972. Battistini, G. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 25-36(May 1973). (In Italian).

The present status of nuclear activities in Italy, the work done in 1972, and the development prospects are reviewed. Particular stress was laid on major nuclear plant contracts awarded to Italy's leading nuclear groups by foreign clients, in particular from Germany. (auth)

23358 1973 DatF-KTG REACTOR CONFERENCE IN KARLSRUHE. Reactor Meeting. Kuesters, H. (Kernforschungszentrum, Karlsruhe, Ger.); Kummerer, K.; Stueger, R.; Hossner, R. Atomwirt., Atomtech.; 18: No. 7, 343-348(1973). (In German).

The reactor conference had the theme Scientific and Technological bases for the further development of nuclear technology in the second half of the decade. The number of participants was the highest so far with 1,800 experts from nuclear research, nuclear technology, the energy industry, and the licensing authorities. The twelve reviewing lectures will be published in Atomwirtschaft. New developments revealed in the four sections are presented. (GE)

23359 BASIC PROGRAMS OF DEVELOPMENT AND UTILIZATION OF NUCLEAR ENERGY, 1972. Kagaku Gijutsucho Geppo; No. 189, 7-10(May 1972). (In Japanese).

Recently, environmental preservation and safety guarantees around nuclear establishments have become urgent problems. The Japan Atomic Energy Committee revised the long-term plan on the development and utilization of nuclear energy, which had been made in 1967. The revised long-term plan is introduced. With regard to power reactors, a prototype advanced thermal reactor is to be constructed, aiming at criticality in 1975, and with regard to fast breeder reactors, an experimental fast reactor is scheduled to reach its criticality in 1974. As for atomic powered ships, "Mutsu" is scheduled to be completed at the end of 1972. Before that accomplishment, criticality and power up tests are planned to be performed. As for nuclear power generation, research and development for home-manufactured nuclear plants are to be promoted and financial funds are to be accommodated. An optimal nuclear fuel cycle must be established rapidly, and aiming at starting operation in 1974, construction of a spent fuel reprocessing facility is to be performed. Counterplans for safety involve synthetic researches on the safety of nuclear establishments, processing and disposal of radioactive wastes, as well as securing of the safety and radiation protection around the nuclear establishments. As for nuclear fusion and radiation chemistry, research and development must be performed. Also safeguard techniques must be developed. (JA)

23360 PROGRESS, FUNCTION, AND VALUATION OF NUCLEAR POWER. Haefele, W. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From 107th meeting and 150th anniversary of the German Society for scientists and doctors; Munich, Germany (8 Oct 1972).

The history of the peaceful use of nuclear energy and the economic break-through of the nuclear power plants are described. The following topics are reported: project science ("big science") non-proliferation treaty, reactor safety and reliability, risk, technical progress and publicity, evaluation of nuclear energy and system analysis. (GE)

23361 SECRETARY OF STATE, HAUNSCHILD: NUCLEAR ENERGY FOR THE DEVELOPING COUNTRIES, A CHALLENGE TO THE INDUSTRIAL COUNTRIES. Pressedienst (Bundesmin. Bild. Wiss.); No. 39, 1-5(1972). (In German).

The significance of nuclear energy in the improvement of living conditions in development countries is explained. It is a challenge to the industrial states to not only apply the existing techniques in the development countries but also to develop those especially necessary for these countries. The development of small and medium size reactors is mentioned. It is a considerable task for the IAEA to introduce nuclear energy in the development countries within their medium-term program. The important role that safety measures play in the field of nuclear energy is emphasized. (GE)

23362 CO-OPERATION OF OFFICE FOR POWER STATION AND NETWORK DESIGN WITH SOVIET DESIGN BUREAUS. Energ. Atomtech.; 26: No. 1, 26-29(Jan 1973). (In Hungarian).

Since the foundation of the Office it has been in cooperation with Soviet design bureaus. A considerable period of the Office's life was spent upon the formation of the Dunamenti power station. (auth)

23363 OPERATIONAL EXPERIENCE WITH NUCLEAR POWER INSTALLATIONS IN THE FEDERAL REPUBLIC OF GERMANY. Annual Report for 1972 of the ABE–Committee of Working Party I Engineering and Industry of the German Atom Forum. At. Strom; 19: No. 5/6, 45-65(1973). (In German).

The operating experience in 1972 of the following power reactors: VAK, MZFR, AVR, KRB, KWL, KWO, KKW, KKS, KNK and NS Otto Hahn is reported. The most important operating occurrences are illustrated with diagrams. (GE)

23364 SECOND REPORT FROM THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY. Nuclear Power Policy, Second Report Session 1972–1973. London; Her Majesty's Stationery Office (1973). 15p. 18p.

The Committee reviews progress made in the reorganization of the U. K. reactor industry in the light of the Committee's previous recommendations. It makes further specific recommendations on: the structure of the industry, the selection of the HTR as deserving the major U. K. research and development effort, a reappraisal of the SGHWR; and the position of the Chief Inspector in the Nuclear Installations Inspectorate. (UK)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 23575, 23585, 23604, 23607, 23609, 23648, 23744, 23745, 23748–23750, 23766, 23768, 23770–23772, 23774, 23775, 23781, 23797–23806, 23822, and 23823.

23365 (AAEW-R-886) THERMAL REACTOR TEMPERATURE COEFFICIENT STUDIES IN THE UNITED KINGDOM. Askew, J. R.; Fayers, F. J.; Fox, W. N. (Atomic Energy Establisment, Winfrith (England)). Jul 1973. 19p. (EACRP-U-49). Dep. NTIS (U.S. Sales Only) $3.00.

Comparisons between measurement and prediction of the temperature coefficients of light water, heavy water and graphite moderated lattices are presented. Those lattices for which the basic cell calculation has been performed using the WIMS code or an equivalent are presented. Measurements in clean, uniform lattices, as well as zero energy and power reactors, are included. The discrepancies for light water, heavy water and graphite are approximately 5×10^{-5} $\Delta k/°C$, 3×10^{-5} $\Delta k/°C$ and 1×10^{-5} $\Delta k/°C$. 29 references. (auth)

23366 (CONF-721018-26) STREAMING OF NEUTRONS AND GAMMA-RAYS ALONG REACTOR COOLANT PIPES. Amin, E.; Hehn, G.; Zumach, W. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A systematic investigation was conducted to determine the streaming effect of neutrons and gamma rays along straight reactor coolant pipes. Different dimensions, and various coolants (water, steam, and sodium) were considered. The geometry of the configuration is divided into four zones: the coolant, the

pipe walls, and the thermal insulation embedded in the bulk shield. It was found that a large part of the total streaming effect is due to the thermal insulation zone. This could be reduced by using additional absorber. 7 references. (FR)

23367 (INIS-mf-660/5) FUEL CYCLES, FUEL FAILURES, AND THE MINI-OUTAGE. Jones, C. R. (Transfer Systems, Inc., North Haven, CT). 1972. 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Quick detection and removal of failed fuel are important with regard to economics and safety, because there is a need to reduce the operator exposure and the release of fission products to the environment. Time and motion studies were made for operations during an outage. New equipment for fast and reliable refueling including rapid detection and removal of failed fuel is being developed. Refueling of an 1100 MW(e) boiling water reactor (BWR) can now be done within 5 days. (INIS)

23368 (MRR-116) PREINVESTIGATIONS FOR TESTING FUNCTIONS OF TECHNICAL SAFETY ARRANGEMENTS WITH CHECKING PROCEDURES. Hawickhorst, W. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Jan 1973. 44p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Some basic aspects of the development of computerized checking procedures and their application to engineered safeguards of nuclear power plants are discussed. The investigations are illustrated by application to the emergency core cooling system of a boiling water reactor. 12 references. (auth)

23369 (MRR-120) RELIABILITY TESTS ON THE ISOLATING AMPLIFIER OF A REACTOR PROTECTION SYSTEM. Weil, L. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Mar 1973. 63p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Tests on the isolating amplifier of the reactor protection system of a boiling water reactor carried out within the "reliability" research project are described. As it has been done several times before, all component faults have been experimentally simulated and the failure probabilities depending on the failure modes have been evaluated by including the component failure rates. In addition, tests were made to find out if and to which degree component faults, RF-interferences at the output terminals and wrong connections to the supply voltages may retroact to the input terminals of the amplifier, thus allowing false signals to be transferred to unaffected redundant measuring channels. 4 references. (auth)

23370 (NEDO-10625) POWER GENERATION IN A BWR FOLLOWING NORMAL SHUTDOWN OR LOSS-OF-COOLANT ACCIDENT CONDITIONS. Licensing Topical Report. Scatena, G. J.; Upham, G. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr 1973. 131p.

The decay heat and fission power generation following a loss-of-coolant accident (LOCA) and a normal shutdown are investigated to determine the appropriate power decay curve for these conditions. For the fission power contribution, both the magnitude of the power generation and the model used in its determination are presented. In assessing the decay energy contribution from the ^{235}U fission products and the activation products (^{239}U and ^{239}Np), a review was made of the most current data to determine an appropriate decay-heat curve which is representative of the mean of the data. A Monte Carlo statistical analysis was performed on this mean curve to evaluate the effects of both systematic and random experimental error. The results of this analysis served as the basis for formulating a decay-heat curve which is recommended for use in LOCA analyses. This recommended curve is at the 2σ limit above the data. Comparison of this recommended curve to the General Electric standard, developed by May and Witt and used for over eight years, indicates that the May–Witt curve is in the range of 6 to 12% above the recommended curve for times typical of a LOCA (0–1000 seconds). For times after shutdown greater than 10^3 seconds, the difference is less than 5%. Also, comparison to the AEC curve promulgated for LOCA analysis indicates that the AEC curve is generally 25 to 35% higher than the mean fit to the data (for times of interest during a LOCA) and 20 to 30% higher than the 2σ limit of the data. The results of the Monte Carlo analysis indicate that the fractional uncertainty is approximately constant over the time range of 0 to 10^6 seconds after shutdown with a standard deviation ranging from 1.5 to 2.5% of the total. This is considerably less uncertainty than that suggested by the proposed ANS-5 Standard. (auth)

23371 (SRARI-P-151) EFFECT OF BORIC ACID ON THE COOLANT HARDNESS VALUE OF A BOILING WATER REACTOR. Zabelin, A. I. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Boric acid promotes the transition of salts from the scale deposits into the ionic state. The corrosion products contained in scale as sorbed inclusions also transform into a liquid phase. The possible mechanism of this transition may be explained by specific functions of the boric acid acting as a chemical inductor. (auth)

23372 (SWRI-2154-P-11-21) 1971 INSERVICE EXAMINATION OF LACROSSE BOILING WATER REACTOR (LACBWR). (Southwest Research Inst., San Antonio, Tex.). Mar 1973. Contract AT(11-1)-2154. 35p. Dep. NTIS $3.75.

Selected components of the LaCrosse Boiling Water Reactor (LACBWR) Nuclear Station were nondestructively examined during the scheduled shutdown in September–October 1971. Originally selected for examination were lamination area around recirculation outlet Nozzle No. 1, auxiliary core spray 6-in. line welds, auxiliary core spray nozzle extension welds, and reactor pressure vessel closure head studs and nuts. Because of stud failure during removal, this last examination became a separate program and is reported in SwRI Report 2154-20 "An Investigation of Failures of LACBWR Vessel Closure Studs," December 1971. No code-rejectable indications were found during the examination of the auxiliary core spray system welds or the auxiliary core spray nozzle extension welds. (auth)

23373 (TID-8200-R28) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1973. (Office of the Assistant General Manager for Energy and Development (AEC), Washington, D. C. (USA)). 1973. 42p. Dep. NTIS $4.00.

Information is tabulated on nuclear reactor and critical assembly facilities in operation, shut down, under construction, or planned. Data are included on name, location, type, power, and startup date. (DCC)

23374 BURNER-FLAME ARRESTER FOR BURNING OFF-GAS FROM A BOILING WATER REACTOR POWER PLANT. Moore, G. E.; Tomlinson, L. H. (to General Electric Co.). U. S. Patent 3,740,313. 19 Jun 1973. Filed date 1 Jul 1971. 4p.

A cooled porous plug device in combination with a continuous ignition source is used for burning off explosive mixtures of contaminated radiolytic hydrogen-oxygen gas flow discharged from the steam turbine cycle of a boiling water nuclear power reactor. Optional use of a second cooled porous plug is shown, the second porous plug being located downstream of the burner to function as a heat exchanger to cool the combustion products for controlled condensation of the water vapor. (Official Gazette)

23375 WUERGASSEN NUCLEAR POWER PLANT: OVERLOADING AND LEAKAGE OF THE CONDENSATION CHAMBER. IRS Kurz Inform., Reihe B; No. 4, 1-6(1972). (In German).

There was a disturbance on April 12, 1972 during the first series of test operations for the commissioning of the reactor which were run at 58% of the rated output. In the course of a run to test the relief valves of the main steam lead, one of the relief valves opened inadvertently and could not be shut again. Thus steam penetrated into the water tank of the condensation chamber in the containment with a flow rate of about 400 t/h and condensed. The additional load on the condensation chamber, due to pressure pulsations induced by steam condensation at high temperatures, caused leaks in the bottom of the condensation chamber which in turn resulted in a flooding of the containment from the sump up to a level of 8 m. There was no release of radioactive substances to the environment. (GE)

23376 NEUTRON NOISE IN BOILING REACTORS. Rothman, G. P. (New South Wales Univ., Kensington, Australia). Atomkernenergie; 21: No. 2, 113-118(1973).

The evaluation of the neutron noise present in boiling reactors at power is considered. A Langevin analysis of the neutron fluctuations arising from random local aggregations of bubbles is presented. This bubble noise depends naturally on bubble size and detailed system geometry but typically fluctuations of approximately 5–10% will occur in the neutron flux as measured by a small detector. The effect of detector size on the measured fluctuations is discussed. Though full information about background noise sources is unavailable, bubble noise should dominate in most boiling reactors and be clearly detectable. Using a detector array, each detector responding mainly to local neutron fluctuations stemming from local voidage variations, important system information such as detection of boiling in a particular channel within the core, determination of the non-boiling heights, and with some reservations, determinations of the boiling regime are obtained. (GE)

23377 PRESENT DESIGN OF BWR CORE AND FUEL. Omura, T. (Tokyo Shibaura Electric Co.). Toshiba Rebyu; 28: No. 5, 508-512(May 1973). (In Japanese).

The design of the core and fuel for the BWR power plant of

which Toshiba is now in charge are described. The standard configuration of core, principal specifications, special features of the design, and some performance characteristics are given. For the fuel, some problematic points in the light of experience with fuel and the countermeasures taken for the present design are described. The design of 8 × 8 fuel bundles to be delivered before long is outlined. (auth)

23378 OPERATIONAL EXPERIENCES WITH REACTOR PROTECTION SYSTEMS. Peuster, K. (Heissdampfreaktor Betriebsgesellschaft mbH, Kahl, Ger.); Knaeulein, H.; Hofmann, W.; Schmidl, J.; Wirth, W. (1972). vp. (In German).

From 8th IRS specialist meeting: the reactor protection system as a main safety problem installation in nuclear power plants; Cologne, Germany (20 Nov 1972).

The expectations held by a public utility towards a reactor protection system are compiled and compared with the features presented by present reactor protection systems and the development undergone with them. A resume is presented of the single reports on practical experiences with the reactor protection systems in the four nuclear power plants of VAK, KRB, KWO, and KWL. (GE)

23379 SAFETY EXPERIENCE IN THE OPERATION OF A BWR STATION IN INDIA. Abraham, P.; Pattnaik, D.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The basic criteria and procedures adopted in India for ensuring safety in the operation of Atomic Power Stations are described. The safeguard features engineered into India's first station at Tarapur, 400 MW(e) twin unit BWR in operation from 1969, to meet the safety standards are described. The design efforts to minimize, control, and monitor the environmental releases are discussed. The limits prescribed for the radioactive effluents from the station are given. Operating experience at Tarapur in achieving the safety standards is summarized. Safety problems encountered in the operation, maintenance, refueling and inspection of the station are described, with special emphasis on those peculiar to developing countries. Unusual occurrences related to safety are analyzed and remedial measures taken to prevent recurrence of such events are discussed. Difficulties in backfitting atomic power stations are highlighted. A summary of the personnel radiation exposures of station personnel during the four years from the commencement of operation is presented. The causes for the high exposures are investigated and included. Data on the solid, liquid and gaseous radioactive wastes released from the station are given. Information on the proposals to augment the existing radwaste systems to reduce the gaseous and liquid waste releases to the environment is provided. Results obtained from the environmental monitoring around the station are presented and discussed. (GE)

23380 SAFETY EXPERIENCE IN OPERATION OF NUCLEAR POWER PLANTS. Morris, P. A.; Engelken, R. H. (Atomic Energy Commission, Washington, DC). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

Some recent experience is described for light water nuclear power plants that have come into operation in the last few years in the U. S. With respect to system and equipment performance, experience is described on inadvertent releases of primary coolant from BWR's, densification of fuel pellets and cladding collapse in PWR's, and overall experience with valves in hydraulic systems. With respect to the performance of plant management, the results of appraisals of seven operating organizations are discussed. (GE)

23381 INTAKE CONSTRUCTION WORK IN HAMAOKA ATOMIC POWER PLANT. Satake, N.; Manabe, K.; Yoshimura, A. (Chubu Electric Power Co. Inc., Nagoya, Japan). Doboku Gakkai-shi; 58: No. 5, 32-38(Apr 1973). (In Japanese).

At the Hamaoka atomic power plant, cooling water up to 33.7 t/sec is taken by an intake tower built 600m off the coast and led to a condenser via an undersea tunnel. The position of the intake tower and the route of the tunnel were decided on the basis of the investigation of the marine conditions and the foundation of the sea bed. The adoption of the shield method is presented using the experience of the excavation of a test tunnel. Excavation of the main tunnel was undertaken by following the method and technique for the test tunneling with some improvements of the shield machine and segment assembling. Construction of the intake tower was built by the caisson method during the season when the sea was calm. Troubles prolonged the construction time. The work of connecting the tunnel and the tower was carried out from the shore by using the test tunnel. (JA)

23382 RELIABILITY-PROOF FOR COMPUTER PROTECTION SYSTEMS. Schruefer, E. (Allgemeine Elektricitaets Gesellschaft, Frankfurt am Main). (1972). vp. (In German).

From 8th IRS specialist meeting: the reactor protection system as a main safety problem installation in nuclear power plants; Cologne, Germany (20 Nov 1972).

AEG intends to install a computerized protection system in the boiling water reactor plants KKB and KKP. The investigations concerning the reliability of the hardware and the quality of the software done in the development of the computerized protection system are described. The claims to reliability and quality are capable of being reached by the present stage of technology. (GE)

23383 RADIOACTIVE WASTE DISPOSAL IN BWR POWER STATIONS. Tani, A. (Nippon Atomic Industry Group Co. Ltd., Tokyo); Nakayama, Y.; Hashimoto, H. Toshiba Rebyu; 28: No. 5, 517-524(May 1973). (In Japanese).

The waste disposal in nuclear power plants is a vital problem for the development of nuclear power utilization. The improvement of the disposal systems in BWR power plants and research on technological problems related to the systems are described. (auth)

23384 MOST IMPROVED BWR NUCLEAR POWER PLANT. Ashihara, E.; Ogawa, N. (Tokyo Shibaura Electric Co.). Toshiba Rebyu; 28: No. 5, 498-502(May 1973). (In Japanese).

In response to wide national expectation on nuclear power generation, Toshiba started research and development in the nuclear field and built up experience in design and construction of nuclear power plants on the basis of accumulated experiences for conventional power stations. A newly improved BWR system was designed by G. E. last year. Toshiba is now endeavoring to develop a safer and more reliable BWR power plant to satisfy special conditions in Japan. (auth)

23385 COOLING WATER BUILDINGS MADE OF LARGE FINISHED COMPONENT PARTS FOR THE BRUNSBUETTEL NUCLEAR POWER PLANT. I. Design and Type of Construction. Buehler, P. Bauingenieur; 48: No. 4, 116-121(1973). (In German).

The equipment necessary for the fresh water passage cooling of this boiling water reactor is described. It consists of an extraction component with a channel, pump construction with recirculating pipes to or from the condenser and the recycling component. (GE)

23386 COOLING WATER BUILDINGS MADE OF LARGE PREFABRICATED PARTS FOR THE BRUNSBUETTEL NUCLEAR POWER PLANT. II. Construction and Erection. Selck, H. D.; Schiemann, D. Bauingenieur; 48: No. 4, 121-124(1973). (In German).

The building constructions of extraction plants, extraction channel and drop structure are described in detail. The particular advantages of prefabricated parts for water constructions of this type are considered both technically and economically. To avoid costly repair under water, completed elements should be used. (GE)

23387 OPERATING PERFORMANCE OF A CHARCOAL ADSORBER SYSTEM IN BWR. Shimozato, A. (Hitachi Ltd., Ibaraki, Japan); Takeshima, M.; Saito, T.; Yusa, H. Hitachi Hyoron; 55: No. 5, 441-446(May 1973). (In Japanese).

A rare gas hold-up device was developed based on the results of studies with a prototype which was completed at Hitachi at the assignment by the Power Reactor Fuel Development Corporation. The device was installed at the Tsuruga Nuclear Power Station, and at the Fukushima Nuclear Power Station Tokyo Electric Power Co. From experiment results obtained at these power plants, it was confirmed that by the installation of this device waste gas from nuclear reactors is deprived of its radioactivity. (auth)

23388 VALVES FOR LIGHT WATER REACTORS. Moersdorf, S. (KSB Klein, Schanzlin und Becker AG, Frankenthal, Ger.). Nucl. Eng. Int.; 18: No. 207, 617-620(Aug 1973).

Most valves for light water reactors are similar to those used in conventional power stations. As they are made of austenitic steel, problems may be encountered with moving parts. With radioactive media flowing through, far higher requirements are imposed on the outward tightness and seal than for conventional stations. These factors are discussed in relation to the use of bellows, packing glands, cover flanges etc., to ensure outward tightness, design for easy servicing, and requirements of the actuators used for remote control of the valves. The importance of corrosion testing, acceptance tests, and cleanliness is stressed. (UK)

23389 MAIN STEAM ISOLATION VALVES FOR BWR AND PWR PLANTS. Juntke, A. (Sulzer Bros., Ltd., Leeds, Eng.). Nucl. Eng. Int.; 18: No. 207, 629-631(Aug 1973).

A new series of quick acting steam isolation valves has been developed for the main steam lines from reactor to turbine in

BWR and PWR plants. The valve and actuator are designed as an integral unit, the system steam operated piston actuator being integrated in the valve housing within the valve pressure boundary. Details are given of the design principles followed in order to achieve the standard of reliability required. A working description is given of the valves. Brief details are also given for the position signals single seat shut off valves, tightness and stroking time. (UK)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 20744, 20980, 23365, 23366, 23373, 23378, 23380, 23388, 23389, 23572, 23575, 23582, 23585, 23599, 23604, 23705, 23706, 23738, 23739, 23742, 23743, 23746, 23747, 23752–23765, 23767, 23769, 23773, 23776–23780, 23782–23796, 23810, 23815, 23821, and 23824.

23390 (BMFT-FBK-73-10) INVESTIGATIONS CONCERNING THE PURIFICATION OF SPENT FUEL PIT WATER DURING REFUELLING AT THE NUCLEAR POWER PLANT OBRIGHEIM. Wille, H.; Stoeckert, H. (Siemens A. G., Erlangen (West Germany)). May 1973. 28p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

During refuelling at KWO investigations concerning the purification of spent fuel pit water were carried out which showed great differences in the capacity for ionogenic and colloidal impurities for the individual filter elements. Because of the small content of suspended matter in the KWO pit water during refuelling, the activity was measured and analysed for the interpretation and the classification of the filters. (auth)

23391 (BMFT-FBK-73-12) INVESTIGATIONS AND RESULTS OF OPERATION EXPERIENCE FOR WATER CHEMISTRY OPTIMIZATION. Neeb, K. H.; Korn, R. (Siemens A. G., Erlangen (West Germany)). May 1973. 120p. (In German). Dep. NTIS (U. S. Sales Only) $8.00.

The optimized water chemistry at KWO is analyzed. The specification and results of operation experience are presented. The behavior of radioactive fission and corrosion products is discussed. 7 references. (auth)

23392 (BMFT-FBK-73-16) EXPERIMENTAL INVESTIGATIONS OF A BALL-COLUMN SYSTEM FOR A 1200-MW PWR. Schmid, P. (Siemens A.G., Erlangen (West Germany)). Jun 1973. 50p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

Extensive experimental investigations were carried out in order to test the behavior during transport of a 4 m long ball-column, to be used in 1200 MW plants. The results obtained were quite satisfactory. As an alternative to the ball-column, comparative measurements were made for the first time on a new activation probe, a 4 m long vanadium helicoil, with the results obtained being surprisingly good. (auth)

23393 (CONF-730427-2) SITING CONSIDERATIONS FOR FUTURE OFFSHORE NUCLEAR ENERGY STATIONS. Klepper, O. H.; Anderson, T. D. (Oak Ridge National Lab., Tenn.). 1973. 25p. Dep. NTIS $3.25.

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973).

Offshore nuclear power plants will be first applied on the East Coast of the U. S. where the water is relatively shallow. If present plans are implemented, the first plant should be operational by 1980. This plant will be a barge-mounted unit protected by a bottom-supported breakwater. Unless unforeseen difficulties are encountered, rapid proliferation of offshore plants can be expected on the East Coast during the 1980's. By 1985 it is not unreasonable to expect an operational offshore plant on the West Coast. Early West Coast Plants may use the breakwater technology as applied to the shallow-water, seismically inactive regions of the Eastern U. S. Widespread application to the West Coast will require the development of plants suitable for deep water. Deep-water plants are also expected to be needed for other coastal areas since suitable sites within say three miles of shore may become scarce. It may be necessary to site plants much farther offshore, in deeper water than is presently envisioned. Fundamental problems to be resolved in the development of offshore plants for deep-water applications, include: developing platforms and mooring systems to accommodate maximum sea conditions; providing protection from ship collision; and providing safeguards against platform sinking. The long-term benefits associated with expanding the scope of applicability of offshore siting would appear to justify the development effort required. (auth)

23394 (DLCS-5000173) SHIPPINGPORT ATOMIC POWER STATION. Quarterly Operating Report, First Quarter 1973. (Duquesne Light Co., Shippingport, PA). 1973. Contract AT(11-1)-292. 20p. Dep. NTIS $3.00.

During the first quarter of 1973, the Shippingport Atomic Power Station was operated as required for Duquesne Light Company system load demand, testing, training and maintenance. The Heat Dissipation System remained shutdown throughout the report period. A reactor shutdown occurred on January 28, 1973 due to a voltage transient in a nuclear protection system power supply when an oil filled filter capacitor failed. The station returned to power operation the same date. Beginning March 16, the Station was shutdown for the semi-annual testing, training, and maintenance program. A cooldown was initiated on March 18 and the station was in a cold plant condition at the end of the report period. Station startup for resumption of power is scheduled for April 15, 1973. During power operation, the contained reactor coolant system leak rate averaged approximately 10-12 gallons per hour. The 1A boiler primary to secondary leak rate remained constant at approximately 1.5 gallons per hour. During the period of the first quarter, one offsite shipment of solid radioactive waste was made. This shipment contained 170-55 gallon drums and 25-30 gallon drums weighing 38,658 pounds and containing 0.1587 curies of activity. (auth)

23395 *(INIS-mf-435, pp 1-119 Chap. 1) INTRODUCTION AND SUMMARY. Chapter 1. Nov 1971.

Information about Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: introduction, summary-station description, and general design criteria. (SW)

23396 (INIS-mf-435, pp 1-5 Chap.2) SITE AND ENVIRONS. Chapter 2. Nov 1971. (In Swedish).

Descriptions of the Ringhals site and environs are given. (SW)

23397 (INIS-mf-436, pp 1-188 Chap. 3) REACTOR. Chapter 3. Nov 1971.

Information about Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: design bases, performance objectives, principle design criteria, summary evaluation, reactor design, nuclear design and evaluation, thermal and hydraulic design and evaluation, mechanical design and evaluation, tests and inspections. (SW)

23398 (INIS-mf-436, pp 1-105 Chap.4) REACTOR COOLANT SYSTEM. Chapter 4. Nov. 1971.

Information about the reactor coolant system for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: design bases, system design and operation, system design evaluation, safety limits and conditions, tests and inspections. An appendix deals with neutron flux and NDT for Reactor Vessel Samples. (SW)

23399 (INIS-mf-437, pp 1-42 Chap.5) CONTAINMENT SYSTEM. Chapter 5. Nov 1971. (In English and Swedish).

Information about the containment system for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: reactor containment, containment isolation system, reactor containment ventilation system, system design evaluation, tests and inspection capability. (SW)

23400 (INIS-mf-437, pp 1-120 Chap.6) ENGINEERED SAFEGUARDS. Chapter 6. Nov 1971.

Information about the engineered safety features for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: general description, equipment-design and fabrication criteria, emergency core cooling system, containment spray system, leakage detection and provisions for the primary and auxiliary coolant loops. (SW)

23401 (INIS-mf-437, pp 1-150 Chap.7) INSTRUMENTATION AND CONTROL. Chapter 7. Nov 1971.

Information about instrumentation and control systems for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: general design criteria, protective systems, nuclear instrumentation, engineered safety features instrumentation, in-core instrumentation, operating control stations, maximum safety settings and minimum conditions for operation, and surveillance requirements. (SW)

23402 (INIS-mf-438, pp 1-64 Chap.8) ELECTRICAL SYSTEMS. Chapter 8. Nov 1971. (In Swedish).

Information about the electrical systems for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: design criteria, generator with auxiliary equipment, connection to external power supply systems, and local power system. (SW)

23403 (INIS-mf-438, pp 1-158 Chap.9) AUXILIARY AND EMERGENCY SYSTEMS. Chapter 9. Nov 1971.

Information about the auxiliary and emergency systems for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: chemical and volume control system, auxiliary coolant systems, auxiliary feedwater system, sampling system, compressed air systems, auxiliary salt water system, fire protection system, demineralization plant, fuel handling system, and ventilation system. (SW)

23404 (INIS-mf-438, pp 1-27 Chap.10) TURBINE AND GENERATOR. Chapter 10. Nov 1971. (In Swedish).

Information about the turbine and generator for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: general description, turbine construction, oil system, turbine regulation, condensers, preheaters, pump system, generator, excitation equipment and voltage regulator. (SW)

23405 (INIS-mf-438, pp 1-61 Chap.11) WASTE DISPOSAL AND RADIATION PROTECTION SYSTEM. Chapter 11. Nov 1971.

Information about waste disposal and the radiation protection system for Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: waste disposal system, radiation monitoring system, and radiation protection. (SW)

23406 (INIS-mf-439, pp 1-25 Chap.12) CONDUCT OF OPERATIONS. Chapter 12. Nov 1971. (In Swedish).

Information about Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: station organization, personnel training, emergency organization, and maintenance. (SW)

23407 (INIS-mf-439, pp 1-35 Chap.13) INITIAL TESTS AND OPERATIONS. Chapter 13. Nov 1971.

Information about initial tests and operations at Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: tests prior to reactor fueling, final station preparation, initial testing in the operating reactor, and operating restrictions. (SW)

23408 (INIS-mf-439, pp 1-144 Chap.14) SAFETY ANALYSIS. Chapter 14. Nov 1971.

Information about Ringhals Nuclear Power Station, Unit 3 is presented under the following main headings: general, core and coolant boundary protection analysis, other single unit accidents, general station accident analysis, and loss-of-coolant accident, including the design basis accident. (SW)

23409 (INIS-mf-660/1) HIGH WATT DENSITY ELECTRIC HEATING ELEMENTS FOR PRESSURIZERS OF PWR'S. Noel, E. (Watlow Electric Manufacturing Co., Saint Louis). 1972. 8p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Electric heating elements for pressurizers of pressurized water reactors (PWR) have been developed. The construction is based on the well known FIREROD heaters which allow for high watt density (212 watts per square inch), and assures long life as well as safe operation. The integral pressure seal was tested to withstand voltages up to 3000 volts and pressures up to 2500 pounds per square inch of hot water (670°F = 355°C). The sheath swaged over is a nominal 1" schedule 40 pipe and can be chosen as required by the operation conditions. (INIS)

23410 (JPRS-58858), pp 1-10) MONITORING THE SEAL OF THE PRIMARY LOOP IN STEAM GENERATORS AT NUCLEAR POWER PLANTS WITH A WATER-MODERATED WATER-COOLED REACTOR. Antonov, V. V.; Zhernov, V. S.; Kiselev, B. L.; Matve'ev, V.; Ryzhov, N. V.; Skatkin, V. M. 26 Apr 1973.

The monitoring of ^{16}N to indicate a leak in steam generator seals of water cooled and water moderated power reactors is described. 8 references. (DCC)

23411 (JPRS-58858, pp 11-17) SELECTION OF COUNTERS FOR MEASURING DELAYED NEUTRONS WHEN MONITORING DAMAGE TO THE FUEL ELEMENTS. Melicher, Z. (Vyskumny ustav Energeticky, Prague); Moravek, J.; Lopuszynski, J.; Ryncarz, J.; Janikowski, A. 26 Apr 1973.

A comparison of proportional counters, corona counters, and fission chambers used to detect failed fuel elements is presented. (DCC)

23412 (JPRS-58858, pp 18-25) GUARANTEE OF CORRECTNESS OF MEASUREMENTS OF NEUTRON FIELD PARAMETERS IN THE REACTORS OF NUCLEAR POWER PLANTS. Garapov, E. F.; Inikhov, A. G.; Lomakin, S. S.; Panfilov, G. G.; Petrov, V. I.; Samoylov, P. S. (All Union Scientific Research Inst. of Instrument Making, Moscow). 26 Apr 1973.

The use of threshold detectors and scintillation counters to measure the neutron spectra in power reactors is described. 17 references. (DCC)

23413 (JPRS-58858, pp 26-31) SYSTEMS FOR MONITORING THE SEAL OF THE VVER-I REACTOR FUEL ELEMENT JACKETS. Aksenov, V. A.; Batenin, I. V.; Borisov, Yu. A.; Golubev, L. I.; Kruglov, V. P.; Samoylov, S. N. (All Union Scientific Research Inst. of Instrument Making, Moscow). 26 Apr 1973.

23414 (JPRS-58858, pp 32-39) SKRE SYSTEM FOR MONITORING THE ENERGY RELEASE DISTRIBUTION IN THE RBMK REACTOR. Emel'yanov, I. Ya.; Konstantinov, L. V.; Postnikov, V. V.; Denisov, V. K.; Gurovich, V. Ya. Apr 1973.

23415 (JPRS-59461) UTILIZING THE REACTOR INSTALLATIONS AT THE NOVO-VORONEZH ATOMIC ELECTRIC POWER PLANT. Ovchinnikov, F. Ya.; Voronin, L. M.; Golubev, L. I. 9 Jul 1973. Translated from pp 1-70 of Ekspluatatsiya Reaktornykh Ustanovok Novo-Voronezhskoy AES, Atomizdat, Moscow, 1972. 92p. NTIS.

Data on the structural elements of the equipment, the technological circuits, recharging the nuclear fuel, the startup and adjustment operations and the operating experience of atomic electric power plants with reactors similar to Novo-Voronezh Atomic Electric Power Plant are discussed. The characteristics of the principal and auxilliary systems of reactors and the basic technical-economic indexes of atomic electric power plants are described. (auth)

23416 (MRR-111) INFORMATION CONTENT OF FLUCTUATION SIGNALS OF PWR TYPE REACTORS IN REGARD TO THE VIBRATION CONTENT OF THE PRESSURE VESSEL INSTALLATION. (Preliminary Investigation AM KWO). Wach, D. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Apr 1972. 166p. (In German). Dep. NTIS (U. S. Sales Only) $10.50.

An investigation was made to determine to what extent additional information about events within the primary system can be obtained from the fluctuations (noise) of the signals from the plant instrumentation of PWR's utilizing suitable analysis methods, and in which way this information interpreted in a correct manner can be used for on-line surveillance of the vibration behaviour of reactor internals. The noise investigations which have been performed at the Obrigheim PWR (KWO) are summarized. The different noise sources, from which the relevant information has to be separated are discussed. Interpretations of the results of the calculations of power spectral densities, phases and coherences are given. (GE)

23417 (WCAP-3385-36) SAXTON PLUTONIUM PROJECT. Quarterly Progress Report for the Period Ending June 30, 1973. Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Jul 1973. Contract AT(11-1)-3044. 29p. Dep. NTIS $4.00.

Destructive evaluations of eight Core 3 end-of-life fuel rods are presented. A fourth section from failed rod JX is metallographically examined to better characterize the failure. Mechanical tests are described. Mass spectrometric burnup analyses are presented. (DCC)

23418 IN-SERVICE INSPECTION OF A NUCLEAR POWER PLANT. Metal Progr.; 104: No. 3, 89-91(Aug 1973).

In-service inspection techniques used by the Southwest Research Institute for the San Onofre Power Reactor Unit 1 are described. (DCC)

23419 PRESSURIZED WATER NUCLEAR REACTOR VESSEL. Bohmann, W.; Rubbert, J.; Groellinger, K. (to Siemens AG). German Patent 1,614,514. 20 Aug 1970. Filed date 26 Apr 1967. (In German).

A pressurized-water nuclear reactor vessel with an installation for pressure reduction is described. A containment shell made of reinforced concrete, technically water-tight and pressure resistant, surrounds the interior structure completely. The reactor cooling coils and the reactor tank as well as the adjacent structure for the reduction of pressure with the condensation tank, the steam generator and a circulating chamber join the two annexed structures. (TSS)

23420 FLOATING NUCLEAR POWER PLANTS FOR OFFSHORE SITING. Collier, A. R.; Nichols, R. C. Energ. Nucl. (Paris); 15: No. 1, 32-40(Jan 1973). (In French).

Offshore siting of nuclear power plants permits them to be located nearer commercial centers without competing for valuable

land. The combination of a floating platform-mounted plant manufactured in a shipyard type facility and an offshore site protected by a breakwater provides advantages in site acquisition, site development, and plant construction. The offshore nuclear plant also offers significant environmental benefits. To fully exploit the offshore nuclear plant concept offshore power systems were formed to manufacture the floating plants. Commitments for the first two offshore plants have been received. However additional orders from other utilities will be required if the enterprise is to be an on-going success for both the electric utility industry and the plant constructor. (FR)

23421 NUCLEAR STEAM SUPPLY SYSTEM MIHAMA NUCLEAR POWER STATION UNIT NO. 2. Tabuchi, Y. (Mitsubishi Heavy Industries, Ltd., Tokyo); Sato, K.; Mochizuki, T. Mitsubishi Juko Giho; 10: No. 2, 271-279(Mar 1973). (In Japanese).

Mihama Nuclear Power Station Unit No. 2 started its commercial operation on July 25, 1972, after four years of construction and test operation. The unit has a capacity of 500 MW(e) power output. It is the first nuclear power station constructed in Japan under full domestic contract. The nuclear steam supply system and turbine generator system were constructed by the Mitsubishi Group as the principal contractor of the unit. The design, manufacturing, installation and test operation of the nuclear steam supply system of the unit are described. (auth)

23422 APPEAL AGAINST GEMEINSCHAFTSKERNKRAFTWERK NECKAR NEAR NECKARWESTHEIM DISMISSED. Energiewirt. Tagesfragen; 23: No. 5, 248-250(1973). (In German).

The administrative court dismissed the appeal against the decision of the administrative court in Stuttgart and rejected a motion to stop the construction of the Gemeinschaftskernkraftwerk Neckar Reactor. The decision is a leading decision inasmuch as the administrative court came to the conclusion that granting a license for the construction of the nuclear power plant does not in itself represent a danger to the public and that there is no reason to cancel the partial license: The appeal was lodged by one of 4,433 individuals who have launched a campaign against the construction of the plant. The grounds on which the judgement is based are given in detail. (GE)

23423 POWER SUPPLY FROM A NUCLEAR POWER STATION TO THE BASF WORKS AT LUDWIGSHAFEN. Guenther, H.; Hildebrandt, H.; Schmitt, W. (Badische Anilin- und Soda-Fabrik, AG, Ludwigshafen, Ger.). VGB Kraftwerkstechnik; 53: No. 7, 418-427(1973). (In German).

The most important design features and the characteristics of process steam generation by the industrial nuclear power plant planned by the BASF are outlined. The integration of the plant into the existing process steam and power supply systems and also emergency procedures for the continuous security of power supply in the event of outage of the nuclear power station are described. (GE)

23424 CHEMICAL CONDITIONING OF THE PRIMARY AND SECONDARY COOLANT CIRCUIT OF PRESSURIZED WATER REACTORS. Riess, R. (Siemens AG, Erlangen, Ger.). (1972). vp. (In German).

From VGB conference on chemistry in nuclear power plants; Essen, Germany (10 Oct 1972).

The chemical conditioning of the first closed high pressure-high temperature water cooling circuit and of the secondary water vapor cooling circuit of a pressurized water reactor is discussed. Within the temperature range significant for the operation of reactors (293 K to critical point) some essential properties of H_2O are changed. The dielectric constant Σ is considered as a function of temperature which is an important parameter for the solubility of salts. The specific volume of H_2O also as a function of temperature, the pH (4 to 10) as f(T), the dissolving power of Fe_3O_4 as f(T) (for secondary cooling circuit), the metal set free as function of the pH value (from 7 to 11), the pH as function of the concentration of Na_3PO_4 + NaOH, the NaOH concentration as a function of the temperature difference between the wall and free solution, as well as the solubility of Na_3PO_4 as function of temperature are discussed. These important parameters, in particular changes in the water chemistry of nuclear power plants, are presented graphically. (GE)

23425 DEVELOPING TRENDS FOR REACTOR PROTECTION SYSTEMS. von Haebler, D. (Siemens AG, Erlangen, Ger.). (1972). vp. (In German).

From 8th IRS specialist meeting: the reactor protection system as a main safety problem installation in nuclear power plants; Cologne, Germany (20 Nov 1972).

For the reactor protection systems used in the PWR manufactured in Germany detailed application is made of the systematics of error analysis. The now proven pulse technique has been introduced into the whole system. Circuit hardware is being perfected. (GE)

23426 CONSTRUCTION OF THE TIHANGE NUCLEAR POWER PLANT AND FRENCH LIGHT WATER PLANTS. Tech. Mod.; 65: No. 3, 37-38(Mar 1973). (In French).

The construction of the Tihange plant is reported. A comparison is made with the Fessenheim I and II plants and the Bugey II and III plants. (FR)

23427 SURVEILLANCE OF PWR INTERNALS VIBRATIONS BY MEANS OF PRESSURE TRANSDUCERS. Possa, G.; Rossini, T.; Vanoli, G. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 6, 327-332(Jun 1973).

A new technique is presented for in-service monitoring of vibrations of PWR pressure vessel internals, based on the analysis of the pressure noise of the PWR primary circuit. The results are given of tests performed by this technique at the PWR reactor of the Trino power station of ENEL in 1970 and 1971. The most remarkable features of the low frequency pressure noise spectra resulted to be two broad peaks (at ~10 Hz and at ~16 Hz), due to pendular pressure oscillations and possibly caused by lateral oscillations of the core barrel. Pressure noise analysis was also found capable of detecting impacts of free metallic pieces conveyed by water flux against the primary circuit walls. (auth)

23428 MULTI-GROUP DIFFUSION ANALYSIS ON KORI REACTOR'S FUEL LOADING PATTERNS. Lee, C. K. J. Korean Inst. Elec. Eng.; 22: No. 1, 21-27(1973).

The multi-group diffusion theory is applied to the analysis of the currently constructing Kori reactor core which is to be refuelled by 3-region fuel loading pattern and also to the comparative study on a conceptually designed 5-region reactor core, under the condition that, apart from the thermal-hydraulic considerations, all the input data referred to are assumed to be identical for both cases. The numerical calculation is carried out for quantitative analysis of the characteristics of the two fuel loading patterns, and the calculated results show that, so far as the nuclear aspects are concerned, the characteristics of the 5-region reactor core are proved to be superior to those of Kori's 3-region reactor core in general. (Korean Sci. Abstr.)

23429 HYDRODYNAMIC CALCULATION OF THE PRIMARY COOLING CIRCUIT IN PWR TYPE NUCLEAR POWER PLANTS. Danila, N.; Licsandru-Isbasescu, E.; Naiu-Adamesteanu, J. Stud. Cercet. Energ. Electrotech.; 22: No. 3, 545-558(1972). (In Rumanian).

A mathematical model of computation for the pressure losses of the coolant in the primary circuit of a PWR type nuclear power plant is introduced. The three essential components of the primary cooling circuit, the nuclear reactor, the steam generator and the coolant pipe system, are analysed from this point of view. A general equation of the pressure losses in the primary cooling circuit is established. This model of computation can be extended to nuclear power plants of other types providing the specific nature of coolant and the structural features of primary circuit are properly taken into account. (auth)

23430 BEZNAU II NUCLEAR POWER PLANT. Plant Testing, Start-Up and Initial Operation. Thee, W. B. (WENESE Inc., Brussels). Energy Int.; 9: No. 11, 30-34(Nov 1972).

The design parameters, site, technical data, power history, reactor trips, load rejections, testing, start-up, and initial operation of the 350 MW(e) Beznau-2 power plant in Switzerland are described. (FS)

23431 COMBINATION OF NUCLEAR REACTOR AND MISSILE SHIELD. Frisch, E.; Andrews, H. N. (to Westinghouse Electric Corp.). U. S. Patent 3,752,737. 14 Aug 1973. Filed date 8 Jul 1970. 8p.

There is disclosed the combination of a nuclear reactor with a missile shield which also affords protection in the event of a seismic disturbance. The shield is massive plate of steel or the like with ribs and is mounted above, and connected to, the upper package of the reactor. The plate has holes through which projections from the housings of the retracting mechanism clusters for the control rods pass. In the event of a seismic disturbance the movement of the mechanism clusters is limited by the restraint exerted by the shield plate on the projections. In addition the shield is retractable from the upper package by operation of hydraulic pistons and when retracted locks the rod retracting mechanisms for a refueling operation. (Official Gazette)

23432 NUCLEAR REACTOR PLANT AND MULTIPLE PURPOSE SHIELDING SYSTEM THEREFOR. Naymark, S. (to Nuclear Services Corp.). U. S. Patent 3,752,738. 14 Aug 1973. Filed date 6 Jul 1970. 10p.

A multipurpose compartmented reactor building is described

in which water fillable tankage dispersed about the pressure vessel and the containment vessel of a nuclear reactor provide primary shielding of a primary pressure boundary. The tankage also provides multiple and immediate sources of water for emergency cooling and for flooding the containment boundary around the pressure vessel in the event of vessel rupture to keep the reactor core submerged. The tankage and water therein serve to absorb the energy release generated in a nuclear accident. (Official Gazette)

23433 NUCLEAR REACTOR HAVING IMPROVED COOLANT REFLECTING ARRANGEMENT. Israel, S. L. (to United Nuclear Corp.). U. S. Patent 3,749,640. 31 Jul 1973. Filed date 2 Jun 1970. 6p.

In a liquid-cooled nuclear reactor, coolant deflectors are deployed in a pattern for deflecting the coolant into transverse flow streams which are parallel to the transverse power gradient among adjacent assemblies. In typical pressurized water reactors, these streams are concentric with respect to the intersection of adjacent nuclear fuel assemblies and are oriented so that adjacent concentric streams flow in opposite directions. This deployment of deflectors permits the operation of a reactor at a power level surprisingly higher than can be obtained from using coolant deflector deployments heretofore devised. (Official Gazette)

23434 ESTABLISHING A NUCLEAR VALVE FACILITY. Wolantejus, R. T. (Westinghouse Electric Corp., Cheswick, PA). Nucl. Eng. Int.; 18: No. 207, 624-626(Aug 1973).

The background to the expansion of Westinghouse valve operations to include a line of forged 3–20 m stainless steel gate and check valves is described. The evaluation of the requirements and the resulting development work are discussed. The design features incorporated into the gate valve to minimize package gland leakage are listed. One innovation of the gate valve is a flexible connection between the valve stem and the valve disc, which is used with a co-ordinated guide system. Highly precise and reliable numerically controlled machining centers, lathes and other machinery are used in production, control being from one central computer. Capacities will be 1200 and 2000 units by the end of 1973 and 1974 respectively. (UK)

23435 MAIN STEAM ISOLATION FOR PWR. Fuller, J. A. (Hopkinsons Holdings Ltd., Huddersfield, Eng.). Nucl. Eng. Int.; 18: No. 207, 621-623(Aug 1973).

A description is given of the design and development of a valve for use in pressurized water reactors for isolating the steam generators from the turbine. The requirements are that the valve seals equally effectively in either direction, is independent of external power for emergency closing, and will withstand seismic conditions. Details are given of the work involved in extrapolating the design of a parallel slide venturi gate valve from 13 in bore at 850 psig at 950°F to 30 in bore at 1000 psig saturated steam temperature. To achieve closing under emergency conditions the steam within the valve is used. The program of hydraulic steam tests carried out before final modifications to the design is described. (UK)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 20691, 22097, 23365, 23454, 23606, 23710, 23751, 23807–23809, 23811–23814, and 23816–23820.

23436 (AAEC/E-239) HIGH BURNUP IRRADIATION TESTING OF SPHERICAL BERYLLIUM OXIDE BASED FUEL ELEMENTS FOR A CONCEPTUAL HIGH TEMPERATURE AIR-COOLED REACTOR. Hanna, G. L.; Reeve, K. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Fueled beryllium oxide spheres, with a thin layer of porous BeO separating the fueled core from the unfueled shell, were irradiated at 500°C, 750°C and 1000°C to burnups of 13.4 to 15.6% (U + Th) and fast neutron doses of 1.4×10^{20} to 1.9×10^{20} nvt. The four spheres irradiated at 1000°C were apparently undamaged but the shell had fractured in all those irradiated at 500°C and 750°C. Failure is believed to have been caused by enhanced expansion of the inner regions of the unfueled shell arising from exposure to both fast neutrons and energetic beta-particles. Further work necessary to prove a fuel element design for the proposed application is briefly outlined. (auth)

23437 (GULF-GA-A-12599) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING MAY 31, 1973. (Gulf General Atomic Co., San Diego, Calif.). 29 Jun 1973. Contract AT(04-3)-167. 149p. Dep. NTIS $9.50.

The High-Temperature Gas-cooled Reactor (HTGR) work reported includes studies of basic fission-product distribution mechanisms, recycle fuel studies (including designing and testing of recycle test elements) and exploration of head-end reprocessing methods (as part of a national recycle plan and of a recycle fuel plan), and physics and fuel management studies. Materials studies include irradiation and analysis of fuel particles in capsules to evaluate fuel systems, and basic studies of control materials and of carbon and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

23438 (INIS-mf-660/3) H.T.R.–B.N.D.C.'S LATEST DESIGN AND SUPPORTING DEVELOPMENT IN THE UNITED KINGDOM. Joyce, A. J. (British Nuclear Design and Construction Ltd., Whetstone, Eng.); Thorn, J. D. 1972. 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

British Nuclear Design & Construction submitted a tender to the U. K. Central Electricity Generating Board in April 1971 for a nuclear power station based on a H. T. R. Since that time B. N. D. C. has made improvements to its design, including the gas circuit arrangement, boilers, and steam cycle. Some of these improvements, as well as an alternative fuel element design for which the reactor is suited are described. An outline is given of supporting fuel and materials development work being carried out in the United Kingdom. (INIS)

23439 (INIS-mf-660/6) MAIN FEATURES OF DIRECT CYCLE HELIUM GAS TURBINES INTEGRATED WITH A HIGH TEMPERATURE REACTOR. Burylo, P. (General Electric Co., Gas Turbines Ltd., Whetstone, Eng.). 1972. 13p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The main features and advantages of direct cycle helium gas turbines integrated with a high temperature reactor are described. The proposed design concept is based on a logical extension of existing knowledge and experience on currently built gas cooled reactors and industrial gas turbines. The direct cycle gas turbine offers many advantages in the form of high reliability, safety and simplicity. (INIS)

23440 (JAERI-M-5058) ICARUS. 1: A COMPUTER CODE FOR TRANSIENT ANALYSIS OF THE MULTI-PURPOSE HIGH-TEMPERATURE REACTOR PLANT PERFORMANCE. Ezaki, M.; Shinoda, W.; Mitake, S.; Kawamura, H. (Japan Atomic Energy Research Inst., Tokyo). Nov 1972. 76p. (In Japanese). NTIS (U. S. Sales Only).

Code ICARUS. 1, written in FORTRAN-IV language, is for transient analysis of the plant performance of the multi-purpose high-temperature gas cooled reactor (MHTGR) which is being developed in JAERI. It is a combination of combined reactor kinetics-heat transfer code, heat transfer codes for reformer, steam generator and recuperator, and codes for simulating the transport lag in piping systems. It is used for analysis of the safety of MHTGR plant in design and safety engineering, and for provision of the transient information in selection of the instruments and in plant operation strategy. Features of the code are as follows. (1) The two-dimensional time-dependent heat conduction equation is solved by the finite difference method in R-Z geometry for the average unit cell of each plant element. The reactor kinetics equation is space-independent, and the cooling loops are simplified in one loop. (2) Thermal properties of each region in the core, heat exchangers and piping systems are taken as constant, or as a function of the temperature, pressure, time and location. (3) The pressure and flow-rate of coolant must be given as input, since the pressure distribution in the coolant region is not calculated. (4) In the transient characteristics, reactivity, primary-coolant, feed-water and feed-gas flow rates are the input disturbances. (5) The thermal effect of the fission-product decay power after reactor shut-down is taken into consideration. The code is used with JAERI's digital computer FACOM 230-60. The core area required is about 90 Kiro-words, and computing time is about 20 min. per standard problem. (auth)

23441 (JUL-941-RG) INDUSTRIAL NUCLEAR POWER PLANT WITH HIGH-TEMPERATURE REACTOR PR 500 ("OTTO-PRINCIPLE") FOR THE PRODUCTION OF PROCESS HEAT. Schulten, R.; Krieb, K. H.; Kugeler, K.; Schroeder, G.; Barnert, H.; Dannenbaum, J.; Drescher, H. P.; Finkbeiner, R.; Fuerst, W.; Kugeler, M.; Meyer, H.; Schroer, H.; Zimmermann, F. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Apr 1973. 160p. (In German). Dep. NTIS (U. S. Sales Only) $10.00.

In order to investigate the suitability of the HTR system for the production of process heat, a pebble bed reactor core with the loop designed heat exchanger systems was chosen as a source of heat. The detailed technical description of the whole plant and an analysis of the safety techniques as well as cost calculations

are given. From this study, one can conclude that based on the present state of knowledge, such a plant even with a relatively low efficiency of 500 MW(t) can almost compete economically with conventional plants. (GE)

23442 (NP-19812, pp 70-88) HIGH TEMPERATURE REACTOR FROM THE VIEWPOINT OF A POWER SUPPLY COMPANY. Schwarz, D. (Vereinigte Elektrizitaetswerke Westfalen A. G., Dortmund, Ger.). May 1973. (In German).

The Vereinigten Elektrizitaetswerke Westfalen, with 5 other German utilities, is a participant in the THTR project. The main features of this reactor, and of high temperature gas-cooled reactors generally, are compared with those of light water reactors, and the reasons for the choice of the HTR given. The principal advantages lie in the field of reactor safety and also the ability to use conventional turbines with superheat. Extensions of the technology to high temperature process heat, direct cycle helium turbines and even to a hydrogen-based energy distribution are also discussed. (NO)

23443 (RD/B/N-2618) ANALYSIS OF REACTIVITY AND POWER DISTRIBUTION MEASUREMENTS ON AN AXIALLY AND RADIALLY NON-UNIFORM CAGR-TYPE REACTOR. Ballard, P. J.; Howarth, N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Apr 1973. 67p. (RPC/RPNK/P-(73)26). Dep. NTIS (U.S. Sales Only) $5.50.

The three-dimensional homogeneous and heterogeneous reactor codes SKIP and HET were compared with measurements performed in a complex critical CAGR type assembly. The reactor contained an axially and radially non-uniform fuel loading, and a bank of four interstitial control rods was part-inserted during most of the experiments. Principal measurements were the reactivity worth of the rod insertion, radial and axial measurements of the manganese reaction rate distribution and of the axial variation of cross-cluster cluster gradients in this highly non-uniform reactor. Lattice data for the reactor calculation were obtained from ARGOSY version 5 with the HET dipole boundary coefficients, which control radial streaming being supplied by a FLOW collision probability calculation. 22 references. (auth)

23444 GAS COOLED NUCLEAR REACTORS. Rapier, A. C. (to United Kingdom Atomic Energy Authority). British Patent 1,314,942. 26 Apr 1973. Filed date 22 Mar 1971. 4p.

Reference is made to gas cooled reactors of the kind using cylindrical tubular fuel elements stacked within vertical channels formed by stacked graphite blocks with cylindrical bores. In the arrangement described the fuel elements have chamfers at each end and are centrally positioned within the bores by annular guide disks having conical seatings abutting the fuel element chamfers. The guide disks have inside and outside diameters equal to the inside and outside diameters of the tubular fuel elements, and each disk has at least three spaced lugs extending radially from its periphery to the channel wall, at least one disk in each channel being secured by its lugs to the channel wall to support surmounting fuel elements and disks. In a preferred construction each graphite block houses two stacked fuel elements that are supported by a lower annular guide disk and are guided by intermediate and upper guide disks. The arrangement provides that the fuel elements are firmly positioned centrally in the channels and vibration is avoided. The inner and outer flow passages are also maintained in alignment and pressure drop is low and heat transfer is uniform. Thermal expansion and irradiation growth are accommodated by relative movement at the conical seatings producing vertical growth. (UK)

23445 NUCLEAR REACTOR FUEL PINS. Prince, K.; Saunders, A. C. A. (to United Kingdom Atomic Energy Authority). British Patent 1,314,248. 18 Apr 1973. Filed date 17 Jun 1970. 3p.

Reference is made to fuel pins for high temperature gas cooled reactors. The fuel pin described comprises a stack of annular compacts of fuel material dispersed in a graphite matrix and enclosed in an annular chamber bounded by two co-axial tubes which are sealably and rigidly joined together at one end to provide an end closure at that end of the chamber, and are slidably joined by a flange or plug member at the other end to form a second end closure. The sliding joint is between the second end closure and the inner tube, and the stack of compacts abuts the second end closure. Under irradiation the compacts shrink radially on to the inner tube and grow longitudinally, thereby imposing a longitudinal tensile stress in the inner tube; since, however, the stack of compacts abuts the second end closure, and the tubes are joined at the other end closure, longitudinal growth of the compacts is restrained by both inner and outer tubes, thus reducing the longitudinal stress and strain in the inner tube. A reactor embodying such fuel pins is also described, wherein the coolant flow is downwardly through the core. (UK)

23446 HTR EMERGENCY COOLING. Kirk, J.; Sell, J. E. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

Emphasis is given to the systems required for emergency core cooling following a reactor trip of a 786 MW(e) HTR. Advantage has been taken of the high thermal storage property of the HTR core in designing an essential electrical system based on continuously running steam turbo alternators. Steam for these sets is taken from four additional pod boilers, of much lower capacity than the main ones, and during normal operation these supply the house load and contribute to the total generating capacity of the station. Following a trip, the main boilers and turbo generator are shut-down and the emergency duty boilers and turbines continue to operate to supply the post trip electrical loads. The gas is circulated through the emergency boilers by electrically driven units but passes in the downwards direction through the boilers. On the secondary side the steam/water passes through the boiler in the upward direction for improved stability at low feed flows. The results of calculations are given which show the required level of post trip cooling for various fault situations. Adequate diversity and redundancy is provided to meet these cooling requirements to an acceptable degree of reliability. (GE)

23447 PLATE-OUT EVALUATION AS A BASIC CRITERION FOR PLANT DESIGN AND SAFETY ANALYSIS IN INDIRECT AND DIRECT CYCLE HTR-SYSTEM. Mielken, G.; Will, M. (Kernforschungsanlage, Juelich, Ger.). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

In modern high-temperature gas-cooled two-cycle reactor plants and also in HTR reactors coupled directly to a gas turbine the design criteria are to a large extent determined by the questions of fission product release from the core and deposition of solid fission products and their distribution within the reactor system. For the indirect cycle system the problem lies mainly in the release of iodine and strontium in the case of a water ingress accident coupled with a leak out of the primary circuit. For the direct cycle system the main difficulties arise from the maintenance of the turbomachinery and eventually repair of gas ducts which have to withstand high strains caused thermodynamically. In this latter case only γ-emitting radioisotopes are important, especially Cs 137 and its successor Ba 137 m. A survey is given on the status of knowledge concerning fission release from the fuel and plate-out distribution in HTR systems. The mathematical models for calculating fission release and fission product deposition and desorption are described. While the motion of fission products from the coated particles to the fuel surfaces is due to mass transport within the graphite, the evaporation from the fuel and the plate-out distribution is based on the mass transport characteristics between coolant and surfaces of the reactor system. Typical results are presented for the indirect and direct cycle systems together with the related radiological effects. (GE)

23448 BEHAVIOR ON PRINCIPLES AND STANDARDS OF REACTOR SAFETY. Cautius, W. (Arbeitsgemeinschaft Versuchs Reaktor GmbH, Duesseldorf). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The AVR reactor has been in operation for more than 4 years. Experience gathered throughout this period resulted in a great deal of important knowledge on the behavior of fission products. It was surprising to discover that the gaseous fission products krypton and xenon are present in the primary circuit of the reactor also in a relatively low concentration. Moreover, the dismounting of special reactor components showed a very low surface contamination of solid fission products. Spherical graphite fuel elements, which are being used in the AVR mixed with other fuel elements, also showed only small traces of contamination. This was indicated by post-irradiation tests. Similar results were obtained when bypass filters were used for repeated purification of the complete helium content of the reactor. However, the question of whether solid fission products deposited on the heat surfaces of the connected steam generators are released in the upper hot part of the reactor remains to be answered. In an attempt to study this problem in detail, a new device was installed in the AVR with which the content of solid fission products can be traced immediately. (GE)

23449 DESIGN OF EMERGENCY COOLING SYSTEMS FOR GAS-COOLED REACTORS. Cave, L. (Pollution Prevention (Consultants) Ltd., Crawley, Eng.). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The fundamental problems in the design of emergency cooling systems for gas-cooled reactors are discussed, and it is shown

that the first essential is to define clearly the safety objectives for the reactor in order that the principles of reliability engineering can be applied to the design of the emergency cooling system. The possible effects of the choice of the main reactor parameters on the design of the emergency cooling system and the interaction of these factors on the overall cost of the reactor are also indicated. The features of various gas-cooled reactor systems which affect the design of the emergency cooling system are examined for a number of reactor types, ranging from the early magnox reactors to gas-cooled fast breeder reactors. It is shown that the use of steam drives for the main gas circulators may ease the problems of attaining the required reliability in the emergency cooling system, but conversely the use of an integrated primary pressure circuit may lead to increased difficulty in the design of the emergency cooling system. Some frequently encountered errors in the design of emergency cooling systems are described. (GE)

23450 PRESSURE FLUCTUATIONS AND MECHANICAL VIBRATIONS OBSERVED IN THE HEAT EXCHANGERS OF THE 3RD STAGE OF THE CHINON POWER PLANT. Leroy, R. (Electricite de France, Chinon). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 98, 18-31(Nov 1972). (In French).

From 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

Abnormal acoustic phenomena were observed in the normal range of operation of the new heat exchangers put into service in Chinon-3 in 1969. These phenomena resulted from large pressure fluctuations occurring in the CO_2 circuit and were accompanied by intense mechanical vibrations in the structures. A brief description is given of the materials concerned and the phenomena observed. Tests and research work which resulted in the development of a simple device for resolving the problem are presented. (FR)

23451 VANDELLOS NUCLEAR POWER PLANT IN SPAIN. Tech. Mod.; 65: No. 3, 13-22(Mar 1973). (In French).

Similarities between the Vandellos power plant and the Saint-Laurent-des-Eaux power plant are recalled. Special attention is given to the particularities arising from the different terrains in which they are located and to the fact that in the first case seawater is used as the coolant and in the second case freshwater. These special considerations and the improvements and modifications made to certain components have changed the general work project from that conceived as a result of the preceding experiment. (FR)

23452 FUEL ELEMENT FOR NEUTRONIC REACTOR AND METHOD OF FABRICATION. Williams, L. C. (to United States Atomic Energy Commission). Australian Patent 427,962. 31 Aug 1972. Priority date 28 Mar 1969, United States of America (USA).

An integral fuel pin and grid structure for use in gas-cooled nuclear reactors are described. Fuel pins are deformed at one end to form rectangular sections and arranged in rows with their deformed portions abutting. A connector pin extends along the length of each row through apertures in the abutting portions and is metallurgically joined along their abutting portions to form rows of integrally connected fuel pins. (AEC)

23453 FUNDAMENTAL STUDIES ON COAL GASIFICATION IN THE UTILIZATION OF THERMAL ENERGY FROM NUCLEAR HIGH TEMPERATURE REACTORS. van Heek, K. H.; Juentgen, H.; Peters, W. (Bergbau-Forschung GmbH, Essen). J. Inst. Fuel; 46: No. 387, 249-258(Jun 1973).

From Gordon conference on coal science; New Hampton, NH (4 Jul 1971).

Future energy demand on the one hand, and the development of high-temperature gas-cooled nuclear reactors on the other, have created new considerations for, and experiments in, producing gas by coal gasification, using nuclear heat. Solution of the problems concerning the kinetics of the gasification of coal with steam under the special pressure and temperature conditions in the combined process are considered. It is shown that the chemical reaction is rate-determining and the influence of the pressure and the particle size is negligible. By choosing types of reactors with residence times of several minutes, lignites can be gasified in the temperature range between 700° and 850°C, coals between 900° and 1000°C. (auth)

23454 COMBINED NUCLEAR GAS TURBINE POWER AND DESALINATION PLANT. Sager, P. H.; Krase, J. M. (Gulf General Atomic Co., San Diego, CA). pp 1299-1304 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The features of a combined high-temperature gas-cooled reactor (HTGR) gas turbine electric generating and multistage flash (MSF) desalination plant are described. The desalination plant utilizes the reject heat from the HTGR gas turbine plant and thereby obtains its thermal energy requirement at essentially zero cost. As a result, the cost of desalted water is decreased by approximately 40% for plant sizes of about 100 million gallons per day (MGD). A desalination plant of nearly 90 MGD can be coupled to a standard size HTGR gas turbine plant with an output of 1100 MW(e) using conventional MSF plant designs. By utilizing a parallel train brine crossover concept, an MSF plant with a capacity of nearly 160 MGD can be coupled to the same HTGR gas turbine plant with a further decrease in water cost. (auth)

23455 COMBINED NUCLEAR PROCESS HEAT AND CURRENT GENERATION. Wiss., Wirt., Polit.; 3: No. 27, 7(1973). (In German).

The basic ideas are given of the published "Memorandum concerning the generation and utilization of nuclear process heat". (auth)

23456 CLOSING THE EXTERNAL FUEL CYCLE OF HIGH TEMPERATURE REACTORS. Merz, E.; Laser, M.; Zimmer, E. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik; 15: No. 6, 249-256(1973). (In German and English).

The success of any future power reactor on the open market depends upon the technical feasibility of recycling the fissile and fertile material and of eliminating the radioactive wastes, without endangering the environment and at competitive prices in comparison with all other energy carriers. The current development status of three pertinent problems connected with high temperature reactor fuels, namely, reprocessing, refabrication and treatment of radioactive wastes are reviewed. The technical problems are solvable and have been largely solved already. Some interim alternatives for high-temperature reactors are discussed and some general remarks on fuel cycle costs are made. (GE)

23457 PRESENTATION AND OPEN DISCUSSION OF THE HHT PROJECT. (1972). vp. (In German).

From meeting on presentation and open discussion of the HHT project; Juelich, Germany (18 Sep 1972).

A summary is given of shortened talks which were given as a basis for a subsequent discussion of the HHT project. Gas turbines and fuel elements were the main features in the whole concept. The statements of the experts were followed by a detailed program for the reorganization of the HHT project. (GE)

23458 CONNECTION FOR THE COOLING OF REACTORS. Bachl, H. German Patent 1,928,127. 10 Dec 1970. Filed date 3 Jun 1969. (In German).

A connection is described, used in the secondary cooling of a high temperature reactor making use of the source of heat in a central gas turbine. At the time the turbo-generator unit stops, a secondary cooling circuit driven independently of the turbo-generator unit is maintained by the lower level of the compressor. (TSS)

23459 BEHAVIOUR OF IODINE ISOTOPES IN A HIGH-TEMPERATURE GAS REACTOR COOLANT CIRCUIT. Rowland, P. R.; Browning, W. E.; Carlyle, M. (Atomic Energy Establishment, Winfrith, Eng.). pp 57-71 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

The behaviour of iodine in the helium primary coolant circuit of the OECD Dragon High-Temperature Reactor has been studied by co-ordinating two techniques for measuring its distribution: (a) by using a diffusion probe technique for estimating the concentration of iodine isotopes at a point in the system between the core gas exit and a primary heat-exchanger inlet; and (b) by removing a primary heat-exchanger, cutting it up and measuring the distribution of iodine along the tube bundle. When the results of the two methods are compared, it is found that about 25% of any given iodine isotope is plated out on the tube bundle (mild steel at about 230°C) for each pass of the coolant through the heat-exchanger. The shape of the iodine distribution profile along the heat-exchanger is also in agreement with a plate-out factor of this order. By study of the diffusional behaviour of iodine isotopes in method (a) it is shown that the iodine is carried by the gas in molecular form rather than by dust. The results are used to calculate reactor core release/birth ratios for iodine isotopes, and by comparison with data obtained for inert gas isotopes it is shown that release of iodine from an HTR core parallels that of xenon of similar half-life. This is important for safety calculations. 11 references. (auth)

23460 DEVELOPMENT OF HIGH-TEMPERATURE REACTORS IN THE FEDERAL REPUBLIC OF GERMANY. III. Com-

parative Cost Benefit Analysis for Various Development Objectives in the Field of High-Temperature Reactors. Schwarz, D. Energ. Tech.; 25: No. 7, 191-194(1973). (In German).

The economical potential of various lines of the high-temperature reactor are examined. The direct cooling cycle with a helium turbine, the process heat generation and the gas-cooled breeder reactor are mentioned. The pebble-bed reactor and the cast-iron pressure container are promoted. (GE)

23461 PROCESS FOR UTILIZING THE HEAT ISSUING FROM HIGH TEMPERATURE EXHAUST GASES PARTICULARLY GASES FROM NUCLEAR REACTORS. Vollhardt, F. (to Siegener AG Greiswald). German Patent 1,928,093. 10 Dec 1970. Filed date 3 Jun 1969. (In German).

The process heat from a high-temperature gas cooled reactor is used to produce ethylene or synthetic gas by thermal dissociation. (FS)

23462 EXPERIENCE WITH THE AVR REACTOR. Cautius, W. (Arbeitsgemeinschaft Versuchs-Reaktor GmbH, Duesseldorf, Ger.). Braunkohle; 25: No. 5, 143-147(1973). (In German).

The AVR power station with a high-temperature reactor has been in operation for more than five years. Good experience was gained with this first high-temperature reactor with spherical-shaped fuel cells. The serious disturbances which were simulated during operation of the AVR proved the excellent safety features of the reactor. This behavior is based last but not least on the spherical shaped fuel cells which have performed superbly in the five years of operation under radiation. The HTR shows great prospects for development in connection with a helium turbine as a single circuit plant and process heat reactor. For this purpose the highest coolant temperatures possible must be obtained. The AVR has been operated at a hot gas temperature of 850°C. An increase to over 900°C is planned. Further possible improvements are discussed to reach extremely high hot gas temperatures. (GE)

23463 WYLFA: LAST OF ITS GENERATION. Energy Int.; 9: No. 7, 18-20(Jul 1972).

The last Magnox nuclear station, Wylfa, rated at 1180 MW(e), is described. It contains two reactors in 96 ft ID spherical prestressed concrete pressure vessels with minimum wall thickness of 11 ft. Within the 80,000 ton vessels, CO_2 is circulated at 400 psia through 6000 fuel channels containing about 50,000 fuel elements and then over 2000 miles of boiler tubes. Over 5,000,000 lbs of steam are generated each reactor hour. Fifty-three million gallons/hr of cooling water are drawn from the sea. A sophisticated data control and processing system consists of two computers which accept 10,000 pieces of information and display the information in digital form. Alarm conditions are analyzed to aid the operator. Non-nuclear power station equipment is also briefly described. (FS)

23464 FUEL ELEMENT AND VENTING SYSTEM USING SAME. Fortescue, P. (to Gulf Energy and Environmental Systems, Inc.). U. S. Patent 3,743,576. 3 Jul 1973. Filed date 3 Oct 1969. 8p.

A venting system is described for a gas cooled nuclear reactor having a plurality of containers for fissionable material. A vent passage system is provided for conducting fission products from the containers to a fission product receiving system. The receiving system and the vent passage system are at a lower pressure than the ambient pressure of the coolant gas. At least one bleed passage is provided adjacent the containers communicating from the cooling system of the reactor to the vent passage system for bleeding coolant gas into the vent passage system, thereby speeding the transportation of fission products to the receiving system, and so reducing the deposition of solids decaying therefrom in the connecting ducting. Also described is a fuel element for use in such a reactor, such fuel elements having a self-containing variable position plug and orifice arrangement for varying the flow of coolant through the fuel element. (Official Gazette)

23465 PRISMATIC ELEMENT FOR HIGH TEMPERATURE NUCLEAR REACTORS. Patarin, L.; Vivien, J. (to Commissariat a l'Energie Atomique). French Patent 2,134,265. 29 Apr 1971. 7p. (In French).

A prismatic element for high temperature nuclear reactors is presented. This element is provided near its upper end with a groove associated with the truncation of at least part of the vertexes of its polygonal cross section (hexagonal or square). The element is provided with an assembly of channels regularly positioned about its axis. Part of these channels may be filled with absorbant elements and another part with the fuel elements, or the whole of the channels may be filled with fuel elements. The side walls of the prismatic elements are provided with joining grooves at least along part of their heights as well as an alternating mortise and tenon system. The upper faces are provided with centralizing systems. The grooves ensure a more reliable handling with the gripping device. (FR)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 23365.

23466 (DP-MS-72-64) RESPONSE MATRIX METHOD FOR TREATING REACTOR CALCULATIONS. Pryor, R. J.; Graves, W. E. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab). [nd]. Contract AT(07-2)-1. 9p. (CONF-730414-8). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

Cell response matrices are derived from the multi-group integral transport equations and used in obtaining solutions to these equations for the neutron flux in large heavy-water-moderated reactors. The method is applied to hexagonal geometry, and an example of its accuracy is provided. (3 references) (auth)

23467 (INIS-mf-660/4) STATUS OF THE SGHWR SYSTEM. Moore, J. (United Kingdom Atomic Energy Authority, Risley, Eng.); Hicks, D.; Bradley, N.; Rowland, I. T. 1972. 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The SGHWR is a direct cycle boiling light water reactor with a heavy water moderator. Distinguishing features are the use of pressure tubes instead of a large pressure vessel, provision of emergency cooling water as a spray operating directly on to fuel pins and the absence of moving mechanical components in the core. Operation of the 100 MW(e) Winfrith reactor for almost 5 years has shown the system to be reliable and accessible for inspection and maintenance. Dynamic characteristics and fuel and materials performance relevant to current commercial designs have been demonstrated. (INIS)

23468 TECHNOLOGICAL INNOVATIONS IN THE EL-600 PROJECT. Recent Results. Boiron, P.; Gauzit, M.; Thome, P. (Groupement Industriel pour l'Etude d'une Chaufferie a Eau Lourde, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 98, 6-17(Nov 1972). (In French).

From 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The principal characteristics of the pressure tube reactor EL-600 are presented with special emphasis being given to the technological developments. Assembly technologies for the channels, axial heat shielding, reactor vessel, and the setting up of the primary and secondary circuits are described. Mechanisms for commanding the control rods and the organization of the control-command system are included. (FR)

23469 BOTTOM FOR MODERATOR TANK OF A HEAVY WATER MODERATED NUCLEAR REACTOR. Senden, H.; Bittighofer, H. (to Mannesmann-Werke GmbH). German Patent 1,614,804. 4 Feb 1971. Filed date 20 Apr 1967. (In German).

A support is described which consists of multiple screened sleeves in the interior and penetrating the bottom for the passage of pressure tubes. At least one thin seal isolates the support structure which is provided with openings for the screened sleeves and is welded to the vessel. The watertight seal is a flat iron plate and the screen sleeves in the radial direction of the collars are joined on the free edges to the borders of the openings. (TSS)

Power Reactors, Breeding

Refer also to abstracts 21919, 23366, 23521, 23544, 23595, 23608, 23707, 23715, 23718, 23740, and 23741.

23470 (ANL-7997) SODIUM TECHNOLOGY FINAL REPORT. Kesser, G. M. (ed.) (Argonne National Lab., Ill.). Apr 1973. Contract W-31-109-eng-38. 58p. AT.

The design of a multipurpose sampler for use at FFTF is nearly complete and testing is in progress; the sampler will provide the capability for obtaining overflow sodium samples, filtering flowing sodium for assay of particulates, and equilibrating metal specimens. The preparation of RDT standards on specifications for measuring and controlling the purity of sodium and cover gas is nearing completion; laboratory work has been concerned with development and testing of the methods to be used for purity measurements. A cover-gas analysis system for separating ^{22}Ne from noble-gas fission products in cover gas, designed for use on FFTF, has been fabricated and will be installed on EBR-II for testing.

Development of a calculational model to describe the generation and transport of tritium in an LMFBR was continued, and an on-line tritium monitor for use in sodium has been fabricated and is being tested; other work on meters has included testing of on-line monitors for oxygen and hydrogen and leak detectors for steam generators, and testing of meter modules. Work has been continued on developing post-exposure testing methods for stainless steel specimens exposed to sodium, and a mathematical model has been used to predict the magnitude and rate of carbon migration in reactor sodium systems. (auth)

23471 (ANL-RDP-1) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1972. (Argonne National Lab., Ill.). 25 Feb 1972. Contract W-31-109-eng-38. 210p. AT.

Highlights of project activities for January 1972 are summarized. The EBR-2 operations, testing, and engineering are reported. Operation of the Core Component Test Loop with FFTF fuel assembly is reviewed. The development of FFTF instrumentation is summarized. Sodium impurity analysis is presented. LMFBR fuels and materials, fuel cycles, physics, and safety are described. TREAT operations are reviewed. Performance testing of Type 304 and Type 316 stainless steel clad PuO_2-UO_2 fuel elements is described. ZPR-9 and ZPPR fast critical experiments are reviewed. The bottom topography of Lake Michigan is presented. (DCC)

23472 (ANL-RDP-2) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1972. (Argonne National Lab., Ill.). 29 Mar 1972. Contract W-31-109-eng-38. 184p. AT.

Highlights of project activities for February 1972 are summarized. The EBR-2 operations, testing, and engineering are reported. Operation of the Core Component Test Loop with FFTF fuel assemblies is reviewed. The development of EBR-2 and FFTF instrumentation is summarized. Sodium monitoring equipment is described. LMFBR fuels and materials, fuel cycles, physics, and safety are reviewed. TREAT operations are described. Radiation effects on the mechanical properties of PuO_2-UO_2, aluminum, aluminum alloys, and Type 304 and Type 316 stainless steels are analyzed. ZPR-6 and ZPPR fast critical experiments are reviewed. (DCC)

23473 (ANL-RDP-3) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1972. (Argonne National Lab., Ill.). 27 Apr 1972. Contract W-31-109-eng-38. 225p. AT.

Highlights of project activities for March 1972 are summarized. The EBR-2 operations, testing, and engineering are reported. Operation of the Core Component Test Loop with FFTF fuel subassembly is reviewed. The development of FFTF instrumentation is summarized. Sodium monitoring and impurity analysis are presented. LMFBR fuels and materials, fuel cycles, physics, and safety are described. TREAT operations are reviewed. Performance testing of Type 304 and Type 316 stainless steel clad PuO_2-UO_2 fuel elements is described. ZPR-9 and ZPPR fast critical experiments are reviewed. Thermal effluent dispersion from power reactor discharges is analyzed. (DCC)

23474 (ANL-RDP-5) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MAY 1972. (Argonne National Lab., Ill.). 26 Jun 1972. Contract W-31-109-eng-38. 190p. AT.

Highlights of project activities for May 1972 are summarized. The EBR-2 operations and testing are reported. Operation of the Core Component Test Loop with FFTF fuel subassembly is reviewed. The development of FFTF instrumentation is summarized. Sodium impurity monitoring equipment is described. LMFBR fuels and materials, fuel cycles, physics, and safety are described. TREAT operations are reviewed. Performance testing of Type 304 and Type 316 stainless steel clad PuO_2-UO_2 fuel elements is described. ZPR-6 and ZPPR fast critical experiments are reviewed. Thermal plume dispersion studies for Point Beach Power Reactor Unit 1 are summarized. (DCC)

23475 (ANL-RDP-6) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1972. (Argonne National Lab., Ill.). 31 Jul 1972. Contract W-31-109-eng-38. 224p. AT.

Highlights of project activities for June 1972 are summarized. The EBR-2 operations and testing are reported. Operation of the Core Component Test Loop with FFTF fuel subassembly is reviewed. The development of FFTF instrumentation is summarized. Sodium monitoring and impurity analysis are presented. LMFBR fuels and materials, fuel cycles, physics, and safety are described. TREAT operations are reviewed. Performance testing of Type 304 and Type 316 stainless steel clad PuO_2-UO_2 fuel elements is described. ZPR-6 and ZPPR fast critical experiments are reviewed. Gas-cooled fast breeder reactor fuel performance is described. (DCC)

23476 (ANL-RDP-8) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, AUGUST 1972. (Argonne National Lab., Ill.). 10 Oct 1972. Contract W-31-109-eng-38. 157p. AT.

Highlights of project activities for August 1972 are summarized. The EBR-2 operations and testing are reported. Sodium monitoring and impurity analysis are presented. LMFBR fuels and materials, fuel cycles, physics, and safety are described. Mechanical properties of UO_2 and Type 316 stainless steel are presented. TREAT operations are reviewed. ZPR-3 and ZPPR fast critical experiments are summarized. Gas-cooled fast breeder reactor fuel performance is described. (DCC)

23477 (ANL-RDP-9) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1972. (Argonne National Lab., Ill.). 30 Oct 1972. Contract W-31-109-eng-38. 205p. AT.

Highlights of project activities for September 1972 are summarized. The EBR-2 operations, testing, and engineering are reported. The development of FFTF instrumentation is summarized. Sodium monitoring equipment is described. LMFBR fuels and materials, fuel cycles, physics, and safety are discussed. TREAT operations are reviewed. Performance testing of UO_2 and PuO_2-UO_2 fuel elements is described. ZPPR fast critical experiments are reviewed. Thermal effluent dispersion studies for Point Beach Power Reactor Unit 1 and Palisades Power Reactor are summarized. (DCC)

23478 (ANL-RDP-10) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1972. (Argonne National Lab., Ill.). 30 Nov 1972. Contract W-31-109-eng-38. 227p. AT.

Highlights of project activities for October 1972 are summarized. The EBR-2 operations and testing are reported. The development of EBR-2 instrumentation is summarized. Sodium monitoring and impurity analysis are presented. LMFBR fuel and materials, fuel cycles, heat transfer and fluid flow, physics, and safety are described. Radiation effects on the mechanical properties of PuO_2-UO_2 aluminum and aluminum alloys, and Type 304 and Type 316 stainless steels are analyzed. TREAT operations are reviewed. ZPR-6 and ZPPR fast critical experiments are presented. Thermal effluent dispersion studies for Point Beach Power Reactor Unit are summarized. (DCC)

23479 (ANL-RDP-11) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, NOVEMBER 1972. (Argonne National Lab., Ill.). 2 Jan 1973. Contract W-31-109-eng-38. 190p. AT.

Highlights of project activities for November 1972 are summarized. The EBR-2 operations, testing, and engineering are reported. The development of FFTF and EBR-2 instrumentation is summarized. The effects of liquid sodium on the corrosion of Type 304 and Type 316 stainless steels are analyzed. Radiation effects on the mechanical properties of PuO_2-UO_2 and Type 304 and Type 316 stainless steels are presented. LMFBR fuels and materials, fuel cycles, heat transfer and fluid flow, physics, and safety are described. ZPR and ZPPR fast critical experiments are presented. TREAT operations are reviewed. Gas-cooled fast breeder reactor fuel cladding performance is analyzed. (DCC)

23480 (ANL-RDP-17) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1973. (Argonne National Lab., Ill.). 26 Jul 1973. Contract W-31-109-eng-38. 54p. AT.

Highlights of project activities for June 1973 are summarized. The ERB-2 operations and testing are reported. The development of LMFBR and EBR-2 instrumentation is summarized. Studies of LMFBR fuels and materials, fuel cycles, fluid flow, physics, and safety are described. Performance testing of stainless steel clad PuO_2-UO_2 fuel elements is reviewed. ZPPR fast critical experiments are described. Gas-cooled fast breeder reactor fuel element performance is analyzed. (DCC)

23481 (EURFNR-1093) FAST BREEDER PROJECT. First Quarterly Report, 1973. Hueper, R. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany)). May 1973. 189p. Dep. NTIS $11.50.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Highlights of project activities for January to March 1973 are summarized. Performance testing of steel clad PuO_2-UO_2 fuel pins is reviewed. The effects of liquid sodium on the corrosion of austenitic steels are described. Methods for determining fission rates are reported in connection with measurements in SNEAK. LMFBR fuels and materials, physics, safety, and instrumentation are described. (auth)

23482 (GEAP-10798) CORE RESTRAINT SYSTEM TESTS AND ANALYSIS. Phase 1: Planar Externally Clamped Core. Marian, V. R.; Marron, J. V. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Mar 1973. Contract AT(04-3)-893. 58p. Dep. NTIS $5.00.

Tests of a core restraint system employing external yokes to load and compact the reactor core were conducted using the Planar Clamping Model (PCM) test facility at HEDL. The operation of the FTR core restraint mechanisms, core component stiffness, load and friction characteristics, and the dimensions and tolerances were simulated to the extent possible in a planar mock-up. Important characteristics of hex channel arrays when subjected to inward-directed restraint loads were observed, photographed, and measured. All tests were conducted using an array of 199 aluminum alloy channels, each 4.719 ± 0.001 inches across flats, 0.270 inch in wall thickness, and 4 inches long. Each channel was flame-sprayed with a coating of alumina (Al_2O_3) 0.0025 inch thick to increase the interchannel coefficient of friction to a value between 0.7 and 0.76. The three series of tests run included: Load Distribution Tests, Dependence of Core Compaction on Yoke Load Sequencing and Effects of Lateral Forces on Compaction. (auth)

23483 (INIS-mf-660/7, pp vp Paper 1) PHENIX: CONSTRUCTION AND PRE-OPERATIONAL EXPERIENCE. Megy, J. (CEN de Saclay, Gif-sur-Yvette, France); Guillemard, B.; Robert, E.; Crette, J. P.; Labat, P. 1972. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The construction of the fast breeder power reactor Phenix, with 563 MW(t), 560°C outlet sodium temperature, began in 1968. Site commissioning is now underway, and start up is to take place by mid 1973. The performance of satisfactory rated power operation of Phenix should provide adequate foundations for a design and realization of a 1200 MW(e) power plant. (INIS)

23484 (INIS-mf-660/7, pp vp Paper 11) DEVELOPMENT OF SOME TECHNIQUES OF TESTING AND FABRICATION OF THE CORE VESSEL OF THE SODIUM-COOLED FAST REACTOR. Payan, G. (Societe Creusot-Loire, Courbevoie, France); Milan, D.; Savornin, B. 1972. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The core vessels of sodium-cooled fast reactors present problems in study and fabrication that are both critical and very specific. The state of certain advanced studies undertaken on the manufacture of the core vessel of the Phenix reactor is described. A program for the calculation of thermoelasticity was used to evaluate the mechanical resistance of the structures. It was known that creep deformations must be considered. The necessary precautions in construction were taken. Experiments were undertaken on the hazardous vibrations induced by the turbulence of the discharge. The mathematical relations between the excitation spectrum and the increasing response amplitude of the structures were established. In addition, electron beam welding was studied. The corresponding set of tools was made, and a method to control the welds by ultrasound was established. The joining of large sheets of stainless steel in a secure manner was accomplished. (INIS)

23485 (INIS-mf-660/7, pp vp Paper 15) SOME ASPECTS OF SODIUM PUMPS FOR THE FUTURE COMMERCIAL BREEDER REACTOR. Raczynski, W. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Bois Colombes, France); Cazes, M.; Refoubelet, P. 1972. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The Hispano-Suiza Division has already had a great deal of experience with the manufacture and development of various liquid metal mechanical pumps. Some aspects of the development of sodium pumps for use in planned 1200-MW(e) commercial breeder reactors are discussed. An appendix gives the general characteristics of the drive mechanism of the variable speed pump for energy recovery developed for the Phenix reactor. (tr-INIS)

23486 (MITNE-143) LMFBR BLANKET PHYSICS PROJECT PROGRESS REPORT NO. 3. Driscoll, M. J.; Lanning, D. D.; Kaplan, I. (Eds.) (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Jun 1972. Contract AT(11-1)-3060. 194p. (COO-3060-6). AT.

An experimental program for the investigation of the neutronics of benchmark mock-ups of LMFBR blankets is reviewed. During the period covered by the report, July 1, 1971 through June 30, 1972, work was devoted to completion of data analysis on Blanket Mock-Up No. 2, a simulation of a typical large LMFBR radial blanket and its steel reflector; and to experimental measurements on Blanket Mock-Up No. 3, a graphite reflected blanket. Extensive instrumental neutron spectroscopy data from Blanket Mock-Up No. 2 (from ^3He, ^6Li and p-recoil spectrometers) are analyzed; as are foil activation traverses from Mock-Up No. 3. Some systematic discrepancies are noted, but in general the agreement between multigroup calculations and the experimental data is good. Analysis of advanced blanket configurations is also reported. (auth)

23487 (ORNL-4902(Vol. 2)) NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1973. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 53p. Dep. NTIS $5.45.

The items in this report are presented under the following headings: reactor cross-section studies, reactor core studies, and reactor shielding. Most of the work is oriented toward the LMFBR program. With a few exceptions, the items contained herein are abstracts or summaries of papers which have appeared elsewhere. (RWR)

23488 (ORNL-TM-4343) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR JUNE 1973. 189a No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N.; Freestone, R. M. Jr.; Kam, F. B. K. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 39p. AT.

The research program results presented include the description and evaluation of two-parameter hydrogen counter spectrum measurements in the energy range 10 to 140 keV; the measurement of gamma-ray heating in a Westinghouse radial shield configuration using thermoluminescent dosimeters; and the calculation and measurement of gamma-ray heating in iron. The latter work was done to evaluate the use of thermoluminescent dosimeters in shielding-type situations. (auth)

23489 (RD/B/N-2545) LIQUID SODIUM-HYDROGEN SYSTEM: THERMODYNAMIC CONSIDERATIONS. Hobdell, M. R.; Whittingham, A. C. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

A significant amount of hydrogen from various sources may be present in the secondary sodium circuit of a sodium cooled fast reactor. Hydrogen dissolves in liquid sodium and will be distributed between the argon cover gas and liquid sodium phases. A basic understanding of the nature of this hydrogen distribution is necessary to anticipate both steady state hydrogen pressures and dissolved hydrogen levels in the liquid sodium under various operating conditions. Thermodynamic aspects of metal-hydrogen systems with particular reference to the liquid sodium-hydrogen system are considered. The nature of the equilibrium pressure-composition isotherms is described, and it is shown how the values of various thermodynamic quantities may be obtained. 7 references. (auth)

23490 (RD/B/N/2546) REVIEW OF PREVIOUS WORK ON THE LIQUID SODIUM-HYDROGEN AND LIQUID SODIUM-HYDROGEN-OXYGEN SYSTEMS. Whittingham, A. C. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1973. 32p. (CFR/BMWP/P-(73)135). Dep. NTIS (U. S. Sales Only) $3.75.

The possibility of a sodium-water reaction in the secondary heat exchangers of a fast reactor necessitates an understanding of chemical interactions in the liquid sodium-hydrogen-oxygen system at relevant temperatures (473-843°K). Previous work on the thermodynamic and kinetic behavior of the liquid sodium-hydrogen and liquid sodium-hydrogen-oxygen systems is reviewed and discussed. It is shown that consistent thermodynamic and kinetic data are not available for these systems, and possible reasons for disagreements in the results of previous work are suggested. The desirability of rigorously controlling oxygen levels in liquid sodium while measuring both thermodynamic and kinetic properties of the liquid sodium-hydrogen system is also indicated. 33 references. (auth)

23491 (SRARI-P-176) CALCULATION OF THE BOR-60 REACTOR ASSEMBLY COOLING IN A GASEOUS MEDIUM. Antipin, G. K.; Kondrat'ev, V. I.; Masnyi, V. F.; Timchenko, V. L. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 36p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Calculational and experimental investigations were performed on the BOR-60 reactor operating in a gaseous cooling medium. (auth)

23492 (WAPD-TM-1076) USE OF RESIDUALS FOR THE ESTIMATION OF ERROR IN APPROXIMATE SYNTHESIS SOLUTIONS (LWBR DEVELOPMENT PROGRAM). Yasinsky, J. B. (Bettis Atomic Lab., Pittsburgh, PA). Jun 1973. Contract AT-11-1-GEN-14. 76p. Dep. NTIS $6.00.

Some ideas on the use of regionwise residuals as error indicators for estimating the error of synthesis solutions of the neutron group diffusion equation are presented. 3 references. (auth)

23493 (WARD-HT-3045-2) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending May 31, 1973. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Aug 1973. Contract AT(11-1)-3045. 103p. AT.

The inelastic characteristics and strain tolerances of Type 304 and Type 316 stainless steel structures which represent LMFBR core components and cooling system components are measured. Design parameters and results of structural testing of the Multi-loading Test Facility are presented. Revised design parameters for the FFTF intermediate heat exchanger inlet nozzle are included. (DCC)

23494 (WARD-NA-3045-3) INTERSTITIAL TRANSFER PROGRAM IMPACT ASSESSMENT REPORT. Part I. Application of Data to FFTF Components. Feduska, A.; Orbon, S.; Schrock, S. L.; Shiels, S. A. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Aug 1973. Contract AT(11-1)-3045. 36p. AT.

The carbon transport information available from the Sodium Compatability Program has now reached a stage of completeness at which it can be used to predict the carbon transfer behavior of specific reactor components. The data have been applied to specific FFTF system components. By making certain assumptions concerning the "carbon potential" of FFTF it has been possible to compute the bulk carbon content of the component as a function of time and also to generate the carbon profiles as a function of thickness and time. Examination of the results showed that for all components either all or some of the wall thickness falls below the 400 ppM minimum usually specified for Types 304 and 316 stainless steel. Some items such as the fuel cladding and the IHX tubing will almost totally decarburize. Others will decarburize to bulk values below 400 ppM and mechanical compensation will be needed. The impact of the depleted surfaces can only be assessed by the design on an individual basis. (auth)

23495 FUEL PIN FOR A LIQUID-METAL-COOLED FAST-BREEDER NUCLEAR REACTOR. Neimark, L. A. (to United States Atomic Energy Commission). U. S. Patent 3,740,314. 19 Jun 1973. Filed date 28 Jan 1972. 4p.

An inherently safe fuel pin for a liquid-metal-cooled fast-breeder nuclear reactor is designed so that axial movement of molten fuel is enhanced and the return of the molten fuel to the fuel zone is prevented if a sudden reactivity insertion causes melting of the fuel. The fuel pin includes an annular upper blanket separated from a solid fuel zone by a conical nozzle. The upper nose of which is welded into a grid plate which extends across the fuel pin and supports the annular upper blanket. Molten fuel is ejected into the central opening of the annular blanket through the conical nozzle which also prevents molten fuel from reentering the fuel zone. (Official Gazette)

23496 METHOD FOR DETECTING AND MONITORING A FUEL ELEMENT FAILURE IN A NUCLEAR REACTOR. Miller, W. E.; Mecham, W. J. (to United States Atomic Energy Commission). U. S. Patent 3,733,249. 15 May 1973. Filed date 2 Nov 1971. 8p.

A method for detecting a fuel element failure in a liquid-sodium-cooled fast breeder reactor and for monitoring the progression thereof, wherein the failure causes sodium coolant to contact the fuel oxide is described. The method comprises determining the level of ^{135}I activity in the liquid sodium resulting from the failed fuel element by separating and counting its daughter ^{135m}Xe utilizing an inert gas sparge. (Official Gazette)

23497 CIVIL ENGINEERING ASPECTS OF THE PHENIX POWER PLANT. Special Problems and Their Solutions. Labat, P.; Lacroix, R.; Magnas, J. P. Ann. Inst. Tech. Batiment Trav. Publics; No. 304, 121-147(Apr 1973). (In French).

The Phenix Power Plant in Marcoule now nearing completion will be the first industrial fast neutron reactor to be built in France. The construction required a large scale site which had to meet a number of specific requirements: substructures waterproof with respect to the underground water table, absence of differential settling between large constructions; earthquake resistance, airtight buildings, accommodation of special forces; considerable overloading. Some original solutions were adopted: metallic lining reinforcing the raft and outside walls, precast prestressed concrete panels joined by post-tension, bonding of metal frames to partly precast prestressed or conventional structures. These arrangements made it possible to meet the required specifications. The tests for the air-tightness of the reactor container gave satisfactory results. (FR)

23498 ARE BURNUPS OF THE ORDER OF 100,000 MWd/t ATTAINABLE WITH FAST BREEDER ELEMENTS? Kummerer, K. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 18: No. 6, 287-290(1973). (In German).

Can burn-ups of the order of 100,000 MWd/t be attained in future large commercial fast breeder reactors? The answer to this question depends among other things on the exact definition of burn-up since there is a factor of two between the maximum pellet burn-up and the average discharge burn-up. Experiments and analysis indicate that the identifiable solutions of the existing problems could be developed so that a peak burn-up of 100,000 MWd/t and hence a mean discharge burn-up of 50,000 MWd/t is attainable. There is a good chance that the average discharge burn-up could be increased to 80,000–100,000 MWd/t. (GE)

23499 HIGH INTEGRITY TUBE-TO-TUBEPLATE BORE WELDS. Perrin, A. J.; Speirs, A. (Babcock and Wilcox Ltd., London). pp 119-127 of Improving Welded Product Design. Abington, Eng.; Welding Inst. (1971).

From improving welded product design conference; London, England (16 Nov 1971).

The design of shell and U tube heat exchangers for the PFR is discussed. Materials are of low alloy 2¼ Cr–1 Mo–Nb and 2¼ Cr–1 Mo steels for the tube and tube sheets of the evaporator, and 316H and 316 stainless steels for the tubes and tubesheets of the superheater and reheater. A heat standard of ultrasonic inspection is carried out to assure the quality of the tubes. High quality tube-to-tube plate bore welds are produced by an automatic process which is described. The welds are first examined using an intrascope when each weld is then examined by a specially developed X-ray radiographic method. In addition leak testing is carried out by helium mass spectrometry. Quality control during the production runs is discussed. (UK)

23500 FUEL SUB-ASSEMBLY FOR A LIQUID-METAL-COOLED FAST REACTOR. Flowers, C. D.; Jakub, M. T. (to United States Atomic Energy Commission). Australian Patent 429-446. 12 Oct 1972. Priority date 10 Apr 1968, United States of America (USA).

A fuel subassembly for a liquid-metal-cooled nuclear reactor operating predominately on fast neutrons and including a plurality of fuel pins disposed within a shroud is described. Each of the fuel pins includes an active zone and a fission-gas plenum with the active zones of all fuel pins being disposed side by side while some of the fission-gas plenums are disposed upstream of the active zones, and the remainder are disposed downstream of the active zone. (AEC)

23501 REFUELING APPARATUS AND METHOD FOR FAST REACTORS. Germer, J. H. (to United States Atomic Energy Commission). Australian Patent 431,530. 2 Jan 1973. Priority date 2 Oct 1968, United States of America (USA).

An apparatus and method are described for transferring fuel bundles in and out of the core of a sodium-cooled fast reactor, utilizing an inert gas filled refueling cell above the reactor and a removable shield plug between the reactor and the refueling cell. Fuel handling is accomplished by a refueling apparatus consisting of two mechanisms, one of which takes the fuel bundles between a storage area and a temporary position adjacent to the reactor core, and the other transfers fuel between this temporary position and the reactor core while maintaining the fuel elements submerged in the sodium coolant to permit continuous removal of decay heat. (AEC)

23502 MOLTEN SALT FUELED NUCLEAR BREEDER REACTOR AND FUEL CELL FOR USE THEREIN. Bettes, E. S. (to United States Atomic Energy Commission). Australian Patent 429,534. 23 Oct 1972. Priority date 20 May 1968, United States of America (USA).

A molten-salt-fueled nuclear breeder reactor which uses vertically oriented graphite fuel cells arranged in a bundle, is described. Each fuel cell comprises three concentric tubulations with axially extending passageways between as well as through the innermost tubulation. Such passageways provide separate flow paths for molten salt containing fissile material and for molten salt containing fertile material. Reactivity control is achieved through displacement of molten salt containing fertile material within the interstices of the fuel cells. (AEC)

23503 SINGLE FLUID MOLTEN SALT NUCLEAR BREEDER REACTOR. Bettes, E. S.; MacPherson, H. G.; Perry, A. M.; Smith, O. L. (to United States Atomic Energy Commission). Australian Patent 429,347. 12 Oct 1972. Priority date 3 Jul 1968, United States of America (USA).

A molten-salt-fueled, graphite-moderated nuclear breeder reactor is described which is characterized by a single salt mixture containing fissile and fertile material and serving as both fuel and blanket fluid. Reactor designs having core and blanket regions which provide different degrees of neutron moderation so that different neutron energy spectrums exist in the two regions are described. The neutron energy spectrums are such that absorption of neutrons by fissile material predominates in the core region and absorption of neutrons by fertile material predominates in the blanket region. (AEC)

23504 300 kW SODIUM TEST LOOP AT CHATOU. Lecocq, P.; Gobert, T. (Electricite de France, Chatou). Bull. Dir. Etud. Rech., Ser. A; No. 3, 65-78(1972). (In French).

The experimental installation consists of a principal sodium loop provided with two test sections: a heating assembly mock-up and a cavitation test bench. The installation was used to study thermodynamic and hydraulic problems connected with the cooling of the Rapsodie and Phenix cores. (FR)

23505 LIQUID METAL HEATED THERMAL INSTALLATIONS FOR ENERGY PRODUCTION. (to Societe Babcock-Atlantique). French Patent 2,120,321. 18 Aug 1972. Filed date 30 Dec 1970. 6p. (In French).

An improvement for thermal installations producing mechanical energy which possess a boiler utilizing liquid metal to produce vapor (e.g., sodium cooled reactors) is presented. It is suggested that the hot vapor obtained from the boiler is used in the re-superheater before being returned to the high pressure part of the turbine. Although in certain installations the vapor is circulated successively in the turbine (as the expansion fluid) and in the re-superheater (as the heating fluid), a system operating in the reserve sense is proposed. (FR)

23506 STUDY OF THE LOCAL CONSEQUENCES SINGLE PHASE OF THE BLOCKING OF THE SUB-CHANNELS OF A FAST LIQUID SODIUM COOLED REACTOR ASSEMBLY. The CABOU Program. Gobert, T.; Lecocq, P. (Electricite de France, Chatou). Bull. Dir. Etud. Rech., Ser. A; No. 3, 79-98(1972). (In French).

The calculation code developed by computer from the configuration of the heating mock-up installed in the 300 MW sodium loop of Chatou is described. This code is intended for the study of the local consequences of the blocking of one or more sub-channels, a single phase being considered. The preliminary theoretical results demonstrate that these consequences depend on the hypotheses adopted for the velocity distribution in the perturbed zone. The importance of complementary hydraulic tests made with water was demonstrated. Nevertheless, only tests with sodium can yield the temperature distribution and enable the mathematical model to be improved. (FR)

23507 RADII OF SURFACE NUCLEATION SITES WHICH INITIATE SODIUM BOILING. Holland, P. K.; Winterton, R. H. S. (Central Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Des.; 24: No. 3, 388-392(1973).

Values for the radii of nucleation sites are calculated from incipient boiling superheat measurements obtained in several different experiments. The radii predicted by applying the pre-boiling pressure history theory to a new cavity model are in agreement with the experimental results. (auth)

23508 EXPLORATORY INVESTIGATION OF AN ELECTRIC POWER PLANT UTILIZING A GASEOUS CORE REACTOR WITH MHD CONVERSION. Williams, J. R.; Yung, Y. Y.; Kirby, K. D.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). pp 1305-1311 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

An exploratory investigation of an electric power plant utilizing a gaseous core reactor with MHD conversion was made in order to determine possible operating regimes for such a system. The reactor would operate with a central region of gaseous ^{233}U mixed with H, surrounded by a region of hydrogen gas, contained within a sperical cavity. Unlike gaseous core rocket reactors, the power reactor would be internally moderated by hydrogen gas within the gaseous uranium core. The graphite or beryllium blanket surrounding the cavity would contain fertile Th. Calculations using a multigroup diffusion program have predicted breeding ratios in the range of 1.08 to 1.17 for core pressures of a few hundred atmospheres. Hydrogen flowing through small slots in the walls of the cavity, nozzle, and MHD duct provides cooling for these surfaces and prevents liquid uranium droplets near the wall from coming into contact with the solid surfaces. This is especially important in the MHD duct to prevent the electrodes from becoming shorted. After exiting the MHD duct, the uranium particles are separated from the hydrogen by a cyclone-type separator. For the space power plant configuration, the hydrogen gas continues to expand through a turbine, is cooled in a radiator, and then compressed and returned to the reactor. Overall plant thermal efficiencies are predicted in the range of 40 to 60% for the space power plant and 65% to 80% for the large ground-based central station plant. (auth)

23509 GERMAN-JAPANESE CO-OPERATION IN THE FAST BREEDER DEVELOPMENT. Habermann, F. W. A. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; No. 2, 42 (1973). (In German).

23510 DISCUSSION ON THE CONSTRUCTION OF A BREEDER REACTOR. At. Inform.; No. 6, p(1973). (In German).

The presidency of the German Atom Forum has expressed its opinion in a discussion on the building of a prototype reactor. The opinion is reproduced here in its exact terms. (GE)

23511 SODIUM VALVE DEVELOPMENT EXPERIENCE. Nucl. Eng. Int.; 18: No. 207, 627-628(Aug 1973).

The problems encountered in the design of valves for use in liquid metal fast breeder reactors are mainly associated with the chemical and physical properties of sodium. The most important features relate to heat transfer, compatibility, hazardous properties, cold spots, and self draining. The essential design features are described and brief summaries are given of the tests carried out in sodium globe valves for PFR, butterfly sodium valves, and sealed butterfly sodium valves, i.e., valves with the sealing characteristics of globe valves and the low pressure loss of butterfly valves. Reference is also made to PFR nonreturn and stop valves. (UK)

23512 NUCLEAR POWER STATION KALKAR. Watzel, G. V. P. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen); Rasche, G. H. Brennst.-Waerme-Kraft; 25: No. 7, 257-266(1973). (In German).

The nuclear power station Kalkar, which is to be equipped with a Na-cooled fast-breeder reactor, has now definitely reached its stage of realization, as work on the site has recently started. A survey of the principles of the fast-breeder reactor as well as of the main technical features of this nuclear power station are reported. The safety engineering requirements which are to be fulfilled by nuclear power stations in the German Federal Republic are also described. (GE)

23513 MEASURING DEVICE FOR THE CONTROL OF THE COOLANT FLOWS IN NUCLEAR REACTOR FUEL ELEMENTS. Sproll, P. (to Siemens AG). German Patent 1,951,918. 6 May 1971. Filed date 15 Oct 1969. (In German).

A measuring device for the control of coolant flow in sodium-cooled fast breeder reactor fuel elements is described. The device is characterized by the fact that the access junctions appears at the lower end of the fuel elements fixed to the core plate. It contains a device for the production and elimination of pressure differentials proportional to the flow, and from the fact that the measuring tubings lead outside the reactor vessel. (TSS)

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Refer also to abstracts 21320, 21401, 21413, 23373, 23459, 23470–23481, 23486, 23493, 23494, 23579–23581, 23588, 23590, 23615, 23704, 23719, and 23827.

23514 (ANL-7992) TRANSIENT SWELLING STUDIES WITH THE GRASS CODE. Dias, J. W.; Poeppel, R. B. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 26p. AT.

The gas-release and -swelling subroutine computer code was used to calculate fission-gas swelling of an oxide fuel during a hypothetical reactor power transient. The effects of bubble-diffusion coefficient, temperature, hydrostatic pressure, fission-induced gas-atom re-solution, temperature gradient, grain boundaries and dislocations, duration of the transient, pretransient bubble size, and pretransient burnup on the resultant swelling were investigated. The results indicate that the diffusion coefficient, temperature, pressure, duration, and burnup have significant effects, whereas the other parameters do not. The investigation must be considered preliminary in that the calculations within the gas-release and -swelling subroutine are made at constant temperature. The transient temperature was approximated by taking small, constant temperature-time steps. The effect of step size on the results was not investigated. 21 references. (auth)

23515 (ANL/EBR-69) INTERIM RESULTS OF END-OF-LIFE EXAMINATION OF MARK-IA FUEL IRRADIATED IN EBR-II SUBASSEMBLY X068A. Olson, N. J.; McClellan, G. C. (Argonne National Lab., Ill.; Argonne National Lab., Idaho Falls, Idaho). Feb 1973. Contract W-31-109-Eng-38. 31p. Dep. NTIS $3.75.

A total of 36 breaches in Mark-IA fuel-element cladding has been obtained in the run-to-cladding-breaching program (subassemblies X068, X068A, and X068B). With the results from subassembly X068A and the initial indications of cladding breaches from subassembly X068B, the test conclusions are presented. 5 references. (auth)

23516 (ANL/EBR-70) POSTIRRADIATION EXAMINATION OF HIGHER-WORTH CONTROL RODS L-4008S AND L-4009S. Walters, L. C.; Laug, M. T.; Ruther, W. E.; Taylor, H. A. Jr.

(Argonne National Lab., Ill.; Argonne National Lab., Idaho Falls, Idaho). May 1973. Contract W-31-109-Eng-38. 90p. Dep. NTIS $6.50.

Two higher-worth control rods (HWCR's) whose Mark-IA fuel had reached maximum burnups of 1.44 and 1.80 at. % were examined as part of the program for qualifying future use of HWCR's to a Mark-IA fuel burnup limit of 1.8 at. % in EBR-II. No galling or chafing was found on the capsules containing the B_4C pellets, no additional stress was imposed on the capsule cladding by swelling of the pellets, and no significant interaction of the pellets and the cladding took place. The pellets retained most of the helium generated by ^{10}B burnup, so the additional stress produced from release of helium was negligible. 11 references. (auth)

23517 (ANL/EBR-71) COMPUTERIZED PREVENTIVE-MAINTENANCE PROGRAM FOR EBR-II REACTOR-ASSOCIATED MECHANICAL AND POWER-ELECTRICAL COMPONENTS. Doe, C. B.; Leman, J. D.; Jacob, D. F.; Ringquist, J. M. (Argonne National Lab., Ill; Argonne National Lab., Idaho Falls, Idaho). Feb 1973. Contract W-31-109-eng-38. 31p. Dep. NTIS $3.75.

The computer program that has been set up to assist in meeting the preventive-maintenance requirements of the EBR-II reactor-associated mechanical and power-electrical components is described. The program can provide several types of listings, including all equipment covered by the program, all equipment due for maintenance, and all equipment due for maintenance under specified plant conditions. Some other areas of the preventive-maintenance program that are not computerized are also described. Possibilities for expansion of the computer program are briefly indicated. (auth)

23518 (ANL/EBR-73) CLADDING STRESSES INDUCED DURING DISASSEMBLY OF EBR-II EXPERIMENTAL-FUEL SUBASSEMBLIES. Chopra, P. S.; Honekamp, J. R. (Argonne National Lab., Ill.; Argonne National Lab., Idaho Falls, Idaho). Feb 1973. Contract W-31-109-Eng-38. 64p. Dep. NTIS $5.25.

During disassembly of irradiated fuel subassemblies after irradiation in EBR-II, resistance to removal of the hexagonal can from the swollen fuel-element cluster has been observed. The stresses on the fuel-element cladding during disassembly have been evaluated. The primary parameters that influence cladding interference stresses are: the pull force on the hexagonal can, the coefficient of friction between the can wall and the cladding; the stiffness of the fuel-element cluster; and the spacer-wire pitch. A simple structural-analysis model has been selected and certain assumptions have been made, with resulting estimates of maximum cladding bending stresses. Current estimates can be improved if the rotational and lateral stiffnesses of the fuel-element cluster are known. A simple test to determine the lateral stiffness of the cluster is possible. (auth)

23519 (ANL/EBR-75) CHARACTERISTICS AND PERFORMANCE OF THE HEATER FACILITY FOR LONG EBR-II COMPONENTS. Divona, C. J.; Halverson, S.; Metcalf, F. E. (Argonne National Lab., Ill; Argonne National Lab., Idaho Falls, Idaho). May 1973. Contract W-31-109-Eng-38. 56p. Dep. NTIS $5.00.

A heater facility for long EBR-II components has been fabricated and tested, and will be installed in one of the existing 38-ft-deep storage holes in the EBR-II reactor building. The facility will be used for pre- and postirradiation heating of In-core Instrumented Test Facility components, instrumented subassemblies, and other EBR-II components. The heater assembly is approximately 33 ft long and 1 ft in diameter. The lower 20 ft is divided into three independent heating zones. Various temperature profiles can be obtained by controlling power to selected zones. A maximum heating rate of 20°F/min can be attained with a heater load of 2.4 lb/ft of stainless steel within the heater. The maximum operating temperature is 900°F. (auth)

23520 (BMBW-FBK-72-29) KAHL SUPERHEATED STEAM REACTOR RESEARCH AND DEVELOPMENT PROGRAM, PHASE C. Final Report. Eckey, H. (Allgemeine Elektricitaets Gesellschaft, AEG-Telefunken, Grosswelzheim (West Germany)). Dec 1972. 223p. (In German). Dep. NTIS (U. S. Sales Only) $13.25.

The aim of the program was the development, production, irradiation and post-irradiation examination of superheat fuel elements for the Heissdampfreaktor Kahl (HDR). Processes for production of corrosion-resistant superheat tubes and endplugs for the connection of steel and zircaloy tubes have been developed. The behavior of the HDR-fuel cladding during operation has been analyzed, taking into account results of different experimental examinations. Five superheat fuel bundles have been tested in the Versuchsreaktor Kahl (VAK). The test bundle H5 was irradiated to the target burnup of 5,000 MWd/tU without any indication of defect. The results of the hot-cell examinations supplied detailed information on the in-pile behavior of the fuel bundles. (GE)

23521 (GEAP-13934) DESIGN BASIS OF THE F9F GRID-SPACED FTR DIAGNOSTIC ASSEMBLY FOR IRRADIATION TESTS IN EBR II. Kaplan, S.; Atcheson, D. B.; Marron, J. V.; Meinhardt, W. G. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). Jan 1973. Contract AT(04-3)-893. 230p. Dep. NTIS $7.60.

F9F is the second in-pile test of a grid-spaced fuel assembly utilizing the straight wave beam grid spacer concept. This diagnostic test is designed to produce conditions in the EBR-II assembly that simulate design-limiting conditions in the LMFBR. Assembly design and design methods will be evaluated and improved based on a comparison of the predicted performance with the actual grid assembly performance observed during the interim and post-irradiation examination. (auth)

23522 (GSF-P-27) MEASURING THE SOURCE STRENGTH OF THE NEUTRON SOURCE NQ II IN THE FRM. Strube, D. (Technische Universitaet, Munich (West Germany)). Jul 1970. 11p. (In German). (PTHM-FRM-108). INIS.

The source strength of the neutron source has been determined by two independent methods. The result obtained by measuring the reactivity of the neutron source at different operating power levels and by flux measurement at the neutron source was $Q = (4.2 \pm 0.8) \times 10^8$ n/sec, whereas the value obtained by the activation of Cu probes according to a modified water bath-gold probe method was $Q = (3.6 \pm 0.3) \times 10^8$ n/sec. (INIS)

23523 (HEDL-SA-519) ANALYTICAL INTERPRETATION OF THE FFTF PLUGGING TEMPERATURE INDICATOR. Yunker, W. H.; McCown, J. J.; Caplinger, W. H. (Hanford Engineering Development Lab., Richland, Wash.). 1973. 16p. (CONF-730611-16). Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Information on the performance characteristics of the plugging temperature indicator in terms of impurity content in the sodium is presented. (DCC)

23524 (HEDL-SA-560) IRRADIATION TESTING OF GAS-RELEASE VENTS IN EBR-II. Christensen, J. A. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 18p. (CONF-730910-9). Dep. NTIS $3.00.

From international conference on irradiation experimentation in fast reactors; Jackson Hole, Wyoming, USA (10 Sep 1973).

Experiments are in progress in EBR-II to evaluate vents for relieving internal He pressure in B_4C control pins. Results of these tests and of parallel ex-reactor studies are expected to allow partial venting of the FTR absorber system during initial operation. (auth)

23525 (HEDL-TME-73-42) ANALYSIS OF THE DOPPLER CONSTANTS OF CORES I AND II OF SEFOR. Harris, R. A. (Hanford Engineering Development Lab., Richland, Wash.). May 1973. Contract AT(45-1)-2170. 69p. Dep. NTIS $5.45.

Experimental verification of the procedures used to calculate the Doppler effect in the FTR has been attempted by exercising them on the two cores of SEFOR. The Doppler constants of each core were inferred from the super-prompt series of transient experiments and then compared with those calculated in a manner consistent with that employed for the design of FTR. This resulted in ratios of calculated to experimental constants (C/E) of 0.91 ± 0.11 and 0.98 ± 0.11 for Cores I and II, respectively (uncertainties are one standard deviation). A comparison between the SEFOR cores and FTR indicates that Core II is quite similar to FTR in material composition and neutron spectrum. The SEFOR Core II results can therefore be used as one way to estimate the accuracy of the Doppler constant calculated for FTR. This estimate indicates that the accuracy of the predicted FTR Doppler effect is characterized by a C/E value of 0.98 ± 0.14. (auth)

23526 (HEDL-TME-73-48) FFTF SECONDARY SODIUM FIRE PROTECTION SYSTEM TEST F1. Hilliard, R. K. Yatabe, J. M. (Hanford Engineering Development Lab., Richland Wash.). Apr 1973. Contract AT(45-1)-2170. 80p. AT.

Sodium fire protection by space isolation was evaluated by conducting a large-scale sodium pool fire within a mockup of an FFTF secondary sodium system pipeway. Seven hundred pounds of 1080°F sodium were spilled rapidly into a 32-ft^2 catch pan located within the air-filled mockup. The bottom of the catch pan was a 4-inch thick slab of concrete. No active counter-measures were used, and control of the consequences of the resulting fire (high temperature, pressure, smoke and hydrogen formation) was afforded solely by the pipeway mockup structure. Although the test concrete was severely damaged and a significant quantity of hydrogen was released, no damage was done to the sheetmetal

mockup and the sodium was confined to the catch pan. Oxygen was depleted to zero concentration by reaction with the sodium, but reentered the enclosure during cooldown while the sodium was still at high temperature. Post-test analysis showed that all of the sodium had reacted, chiefly to Na_2O and to sodium silicates. (auth)

23527 (HEDL-TME-73-52) MULTIPURPOSE SODIUM SAMPLER: OPERATION, SIMULATION, AND ANALYSIS. Fleck, B. J.; Harvey, R. A. (Hanford Engineering Development Lab., Richland, Wash). 21 May 1973. Contract AT(45-1)-2170. 58p. AT.

The Fast Flux Text Facility employs the Multipurpose Sodium Sampler as a vital part of the Sodium Characterization System to ensure that sodium purity meets the requirements for the Heat Transport and the Closed Loop Systems. A mathematical model of the sampler was simulated on a PDP-9 digital computer and utilized to define the operating characteristics and procedures. A water model mockup of the sodium sampler verified the adequacy of the computer model. The sampler and the models along with the results as determined from the models are described. (auth)

23528 (HEDL-TME-73-57) SODIUM ORIFICE EROSION TEST. Hilliard, R. K.; Yatabe, J. M. (Hanford Engineering Development Lab., Richland, Wash.). 30 May 1973. Contract AT(45-1)-2170. 22p. AT.

A brief experimental study was made of the potential damage to a stainless steel orifice operating in 900°F sodium flowing at 120 ft/sec under possible cavitation conditions. No detectable damage was found after 70 days of exposure. 3 references. (auth)

23529 (IFA-FR-98-1973) ANALYSIS OF THE THERMAL SPECTRUM IN VVR-S TYPE CELLS. Boeriu, S.; Cepraga, D.; Cristian, I.; Gheorghiu, E.; Stancu, M.; Turcanu, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 14p. (In Rumanian). Dep. NTIS (U. S. Sales Only) $3.00.

Based on a mathematical development, the conclusion is reached that the THERMOS code can be used to obtain precise data on the thermal spectra in VVR-S type cells, with consideration of the pertinent parameters. Neutron absorption and reflection are considered. THERMOS compatibility has been demonstrated in numerous experiments with light water, and data obtained with it can be used as reference data for burnup and design coding. Cell parameters obtained with THERMOS for VVR-S type cells can be compared with data obtained with other codes. UO_2 and UO_2 + MgO are considered. (TTT)

23530 (KFK-1415) OPERATING STATEMENT FOR THE RESEARCH REACTOR FR2 FOR THE YEAR 1970. Steiger, W.; Wildberg, D. (Kernforschungszentrum, Karlsruhe (West Germany)). Apr 1973. 174p. (In German). Dep. NTIS (U. S. Sales Only) $10.75.

The 10 operation phases (of 5 weeks each) scheduled in the 1970 timetable of the heavy-water moderated research and materials test reactor FR2 have been completed at the design power of 44 MW. Only Phase D experienced a major outage of approximately 62 hours duration due to a disturbance. It had been caused by trouble with experiments FR2-26 (pressurized helium gas loop), FR2-58 (pressurized heavy-water loop), and FR2-64 (thermionic emitter capsules). By request of the scientists performing experiment FR2-2, the last phase of operation, Phase K, was started at a power level reduced to 10 MW for a period of approximately 15 days. In 1970, utilization of the FR2 reactor by experiments again increased relative to the previous year. Besides the three loop experiments known from the previous year (low-temperature in-pile experiment, pressurized helium gas loop, and cryogenic helium gas loop for the "cold source"), which were operated throughout the year, the superheated steam high-pressure loop was operated in phases A through D and the pressurized heavy-water loop was started up in phase E. The capsule test rigs and other in-pile rigs did not exceed the number of 30 in 1970. The beamhole exits were used satisfactorily in 1970. Only the experiments run by IAK at beamholes C2 (Project FR2-24), R6 (Project FR2-69), and T_w (Project FR2-52) were practically not operated at all. Isotope production increased by about 300 capsules as against the previous year, now reaching a total of 1,621 irradiated capsules. 765 capsules were irradiated in the isotope channels of the reactor, 775 in the rabbit system, 81 in the thermal column. In addition, 64 Co-detectors, 1 Ag-detector, 1 Li-detector, 4 gamma ionization chambers, and 510 capsules were irradiated for flux measurements. (GE)

23531 (LIB/TRANS-499) IRRADIATION CAPSULES. Franzetti, F.; Laporte, A.; Nectoux, P.; Perrin, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar 1973. Translated from STI/PUB- 316, pp 105-127. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The problems posed by irradiations in swimming pool reactors of average power are resolved because of the availability of perfected irradiation devices. These devices permit irradiations of various samples, of structural material, and fuel in very different surroundings, studies of corrosion by gas or by liquid metals, and in a temperature range from 150 to more than 2000°C with excellent control. Different irradiation devices with their general characteristics are described. (JSR)

23532 (ORNL-TM-3041) MSRE OPERATOR TRAINING AND OPERATING TECHNIQUES. Guymon, R. H. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 138p. Dep. NTIS $9.00.

The MSRE was a unique, fluid-fuel reactor that operated successfully at ORNL from 1965 through 1969. MSRE operators and supervisors, mostly veteran ORNL employees, were trained and examined within the Molten-Salt Reactor Program. Formal training sessions were held at the beginning of prenuclear testing, just before initial criticality and before the approach to power. Training of replacements and retraining of operators was a continuing effort. The training, the information provided for use by the operators, operations planning and administration, and the use of procedures are described. (auth)

23533 (RISO-119) NUCLEAR HEAT DOSE RATE SEPARATION BY CALCULATION AND MEASUREMENT. Haack, K. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1972. 148p. Dep. NTIS (U. S. Sales Only) $9.50.

An adiabatic and an isothermal rod type calorimeter have been developed. A detailed description of design, construction, instrumentation, and handling equipment is given together with the results from calibrations and measurements. Correction calculations of the heat contributions from thermal- and fast-neutron flux reactions in the calorimeter sample and structure are made in order to isolate the primary γ-heat in each core position. A guide is given on the similar calculations to be done for a rig design in order to estimate the total nuclear heating. Graphs showing the vertical distributions of γ-heat in the fuel elements and the experiment holes of DR 3 are included. 64 references. (auth)

23534 (SLA-73-430) SANDIA PULSED REACTOR II (SPR II): CURIE RELEASE AND DOSE POTENTIAL. Bonzon, L. L. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 32p. Dep. NTIS $4.00.

A study of the effect of the reactor-building ventilation system on curie release to the environment and on personnel dose potential for typical SPR II operations is presented. 8 references. (auth)

23535 (SLA-73-5155) IN PILE TESTING OF FAST BURST REACTOR FUEL MATERIALS. Reuscher, J. A. (Sandia Labs., Albuquerque, N. Mex.). [nd] 27p. (CONF-730212-4). Dep. NTIS $3.50.

From fast pulsed reactor symposium; Alamogordo, New Mexico, USA (20 Feb 1973).

A technique was developed for measuring the thermomechanical properties of fissile materials under conditions of rapid heating. It is now possible to determine the temperature dependence of the speed of sound, modulus of elasticity, and thermal expansion coefficient of uranium alloys under heating conditions which exist in the fuel of a fast burst reactor. (auth)

23536 (WARD-NA-3045-4) EVALUATION OF COATED, DUCT LOAD PAD MATERIALS. Whitlow, G. A.; Meacham, S. A.; Miller, R. L.; Wu, P. C. S. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Jul 1973. Contract AT (11-1)-3045. 48p. AT.

The progress of an experimental program designed to examine the long term sodium behavior of certain candidate low friction coefficient coatings is summarized. These coatings, which may be applied to Type 316 stainless steel or Inconel 718 substrates by a D-Gun or plasma spray process, have been developed for application on FFTF fuel assembly duct load pads. Initial work conducted in an 1160°F, low oxygen, low velocity sodium loop has established that chromium carbide (nichrome binder) coated stainless steel, the reference materials combination, has an acceptable corrosion rate of approximately 0.3 mpy. Titanium carbide based coatings have been shown to be unsuitable for this application. Progress in the areas of thermal cycling (1160 ⇌ 800°F) in sodium and mechanical integrity evaluations using a bend test technique are described. (auth)

23537 EFFECT OF THE $^{238}U(n,\gamma n')$ REACTION IN FAST-NEUTRON SPECTRUM CRITICAL ASSEMBLIES. Hummel, H. H.; Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Sci. Eng.; 50: No. 4, 397-398(Apr 1973).

The effect of the $^{238}U(n,\gamma n')$ reaction upon the integral properties of ZPR-6 Assembly 7 and the Fast Test Reactor has been evaluated. This effect is <3%. (auth)

23538 NEUTRON RADIOGRAPHY AT THE FR2. Schuelken, H. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 13-18(1973). (In German).

A brief description of the principle of neutron radiography is given. Preliminary tests for the design and set-up of a plant at the FR2 are described. Above all this plant is planned for operation with thermal neutrons. (GE)

23539 RELATIONSHIP OF THE EFFECTIVE NEUTRON TEMPERATURE TO THE TEMPERATURE OF THE SURROUNDING MEDIUM DETERMINED BY FISSION TRACK DETECTORS. Su, C. S.; Liu, T. C. (National Tsing Hau Univ., Hsinchu, Taiwan). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 232-234(Apr 1973).

As has already been reported (Lifton and Welch, Radiat. Res.; 45: 35(1971)), the effective neutron temperature in a certain region of a nuclear reactor can be measured by directly counting the induced fission tracks of two fissile materials, ^{239}Pu and ^{235}U, irradiated there simultaneously. The dependence of the effective neutron temperature on the temperature of the medium at a location in the thermal column, toward the core, of the Tsing Hau open pool reactor was investigated. The temperature of the medium surrounding the fission track detector assembly was raised above ambient by means of thermostatically-controlled electric heaters. The ratio of the effective neutron temperature to the medium temperature was found to decrease by approximately 25% from 1.4 to 1.1 as the medium temperature was increased from 30°C to 70°C. (UK)

23540 VOIDS IN CLADDING STEELS OF A BR-5 REACTOR CARBIDE CORE. Bykov, V. N.; Vakhtin, A. G.; Dmitriev, V. D.; Konobeev, Yu. V.; Kostromin, L. G.; Reutov, V. F. At. Energ. (USSR); 34: No. 4, 247-250(Apr 1973). (In Russian).

Results are presented of an investigation by means of an electron microscope of fast neutron radiation-induced voids in the hexahedral jackets and fuel element cladding of BR-5 reactor carbide core over a wide range of irradiation temperatures at integrated fluxes of up to 3.6×10^{22} n/cm^2. An azimuthal variation of swelling was observed in the cladding steel of peripheral fuel elements, which corresponds to the temperature variation. The behavior of radiation-induced voids for various annealing processes is investigated and discussed. (auth)

23541 IRRADIATION COSTS IN A RESEARCH REACTOR. Kochenov, A. S.; Gitsesku, P. At. Energ. (USSR); 34: No. 4, 295-296(Apr 1973). (In Russian).

The cost of irradiation of a given sample by thermal neutrons is not completely determined by neutrons absorbed in the sample but includes the excess neutrons in the flux. The fuel component cost of neutrons was investigated as a function of the size of the neutron flux. Mathematical expressions are derived which relate the degree of burnup of the fuel, breeding coefficient in the medium, and average flux in the core to ultimate irradiation cost. (KSW)

23542 CONTROL OF AIRBORNE RADIOIODINE IN THE LOSS-OF-FLUID TEST (LOFT) FACILITY. Gammill, W. P. (Atomic Energy Commission, Washington, DC). pp 73-77 of Control of Iodine in the Nuclear Industry. Vienna; International Atomic Energy Agency (1973).

From panel on the control of iodine in the nuclear industry; Vienna, Austria (19 Oct 1970). See STI/DOC-10/148; CONF-701077-.

A description is given of the objectives of the loss-of-fluid test (LOFT) program, which is one of the USAEC's major nuclear safety research and development programs, and of the facilities used in this program. A halogen and particulate removal system is an integral part of the heating, ventilating and air-conditioning system of the containment building. The filter train consists of an entrained moisture separator, an electric duct heater, a filter assembly containing both roughing filters and HEPA filters, and iodine-impregnated charcoal adsorbers. The basic objective of the filter system is to reduce the turn-round time between experiments or to permit earlier access to the test chamber following a nuclear experiment. The design efficiency of the filter system is considered to be much greater than would normally be required for a recirculating filter system, but the possibility of operating the system in a single pass mode justifies the higher design efficiency. (auth)

23543 ANALYSIS OF THE XENON REACTIVITY EFFECTS IN WWR-SM TYPE REACTOR. Kubowski, J. (Inst. of Nuclear Research, Warsaw). Atomkernenergie; 21: No. 3, 192-196(1973).

The xenon reactivity characteristics following the power reductions have been measured in the EWA research reactor. The least squares method was applied to evaluate the effective delayed neutron fraction β_{eff} and that was compared with the calculated value. The applicability of the inverse procedure, i.e., of obtaining two operational powers, before and after reduction, from Xe-reactivity transients is examined. The influence of the interference effects of the regulating rods, during their calibration on the xenon reactivity measurements is considered. It is concluded that the proposed techniques can be used as a helpful tool in analysis of the parameters in relatively small thermal power reactors. (GE)

23544 KNK REACTOR: FIRST STEP IN THE SNR 300 PROJECT. Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 71-75 (May 1973). (In Italian).

The history and description of the KNK reactor, in operation at Karlsruhe since August 1972, developed in the framework of Germany's nuclear program as a prototype of sodium-cooled thermal power reactors are presented. (auth)

23545 PHYSICS, CONCEPTUAL DESIGN, AND SAFETY OF A FAST SUPERCRITICAL BLANKET RESEARCH FACILITY. Krauss, F. G. Lafayette, IN; Purdue Univ. (1972). 199p. University Microfilms Order No. 73-15,823.

Thesis (Ph.D.).

The design of a unique and practical fast subcritical instructional and research facility which will be constructed at Purdue University to enable students to carry out meaningful studies in fast reactor blankets is presented. With this facility, fast neutron spectra, plutonium production rates, flux distributions and other physics parameters of fast reactor blankets can be determined. The facility will also provide opportunities for instruction in the area of fast reactors and will be used in conjunction with nuclear engineering courses and laboratories. Research consisted of three separate phases. The first was a physics investigation which optimized the dimensions and compositions of various regions of the facility utilizing surplus government fuel pins and neutron sources. The second phase consisted of a conceptual mechanical design study which was a basis for obtaining a cost estimate. The third phase was a safety study which demonstrated that the facility could be kept subcritical under all conditions, including an inadvertent flooding condition, if several independent safety features were incorporated into the design of the facility. (Diss. Abstr. Int., B)

Production and Materials Testing and Processing Reactors

23546 (ANCR-1080) REACTOR PHYSICS RESULTS FROM THE ATR POWER DEMONSTRATION PROGRAM. Durney, J. L.; Willis, J. B.; Tappendorf, J. C.; Hogg, C. H. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1972. Contract AT(10-1)-1375. 59p. Dep. NTIS $5.45.

The ATR successfully operated at design power (250 MW) for 8750 MWd in a balanced power division and for 6658 MWd in an unbalanced power division. The integrated powers obtained were well in excess of the design criteria of 4250 MWd. Analysis of excess reactivity data during the power demonstrations indicates the maximum core lifetime obtainable is approximately 10,000 MWd. During the approach to full-power operation, stability with respect to xenon oscillation was demonstrated. Reactor noise data were also obtained during the approach to power to establish reference data and to detect any anomalous power-dependent behavior. The power coefficient was measured at the beginning and end of core life in an unbalanced power division. The value obtained was -0.15 ¢ per megawatt increase in reactor power and was independent of the operating time. Neutron flux data were obtained in the flux traps and capsule experiment positions at the beginning and end of core life for comparison with calculations to be completed later. (auth)

23547 (DP-MS-71-13) APPLICATION OF POTENTIAL FLOW THEORY TO REACTOR COOLANT CIRCULATION. Harris, S. D.; Reece, J. W. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab). 17 Dec 1971. Contract AT(07-2)-1. 17p. (CONF-720316-2). Dep. NTIS $3.00.

From eighth annual seminar on thermal sciences; Nashville, Tennessee, USA (23 Mar 1972).

The solution of an asymmetrical flow problem in three-dimensional cylindrical space is presented. The Laplace equation is solved analytically as a boundary value problem, and the results are given in terms of a double Fourier series which involves Bessel functions of the second kind. The equation is solved again numerically as a mixed boundary value problem. The results apply particularly in the case of asymmetric plenum distribution flow in the Savannah River Plant reactors. (auth)

23548 BURNUP DETERMINATION OF IRRADIATED FUELS BY MEANS OF THEIR HEAT OUTPUT. 2. Measurements on

Highly Enriched Uranium Samples at Medium and High Burnup Levels. Debertin, K.; Ramthun, H. (Physikalisch Technische Bundesanstalt, Brunswick). Atomkernenergie; 21: No. 2, 119-122 (1973).

Measurements on five MTR fuel samples of different burnup in the range between 3% and 30% are reported. Good agreement of the calorimetric with the γ-ray spectrometric and mass spectrometric results confirms the supposition that the calorimetric burnup determination can compete with other non-destructive methods. For the integrated value of burnup, the measurement uncertainty was lower than with γ-ray spectrometry. (GE)

Propulsion and Package Reactors

Refer also to abstracts 20895, 20943, and 23574.

23549 (AI-AEC-13069(Vol.1)) SNAP 4 SUMMARY REPORT. Volume I. Applications and Summary. Wetch, J. R. (Atomics International Div., Canoga Park, Calif. (USA)). 20 Jul 1973. Contract AT(04-3)-701. 49p. Dep. NTIS $4.00.

The AEC-sponsored SNAP 4 Program provided the basis for the conceptual design of a compact reactor system employing uranium–zirconium hydride for fuel and moderator, beryllium reflectors for control, and forced-convection boiling water for cooling. The completely self-contained, compact, multipurpose, automatically controlled, transportable nuclear reactor was directly coupled, through a steam separator, to a high-speed, hermetically sealed, turbine-generator unit. The turbine exhausted to a compact high-pressure condenser, and small steam driven turbo-pumps returned the condensate to the reactor. The complete system, which could be designed and built for a specific power rating in the range from 400 to 4,000 kW(e), is adaptable to marine or terrestrial, surface or submerged, fixed or mobile, and arctic or tropic environment. (auth)

23550 (AI-AEC-13069(Vol.2)) SNAP 4 SUMMARY REPORT. Volume II. Systems Description. Marchese, A. R. (ed.). (Atomics International Div., Canoga Park, Calif. (USA)). 18 Jun 1973. Contract AT(04-3)-701. 354p. Dep. NTIS $19.75.

The technical activities conducted by Atomics International for the Atomic Energy Commission, during the period from 1960 to 1965, on the SNAP 4 Program are summarized. The overall objective of this was to develop a multipurpose, automatically controlled, transportable, compact nuclear power system. The concept consists of a uranium–zirconium hydride alloy fueled and moderated, beryllium reflector controlled, forced convection boiling water cooled, compact reactor. The reactor is directly coupled, through a steam separator, to a high-speed hermetically sealed turbine generator unit. The turbine exhausts to a compact high-pressure condenser, and small steam driven turbo-pumps return the condensate through the system to the reactor. The resulting hermetically sealed compact system may reject heat to air or water. The SNAP 4 nuclear power system was designed to be readily transportable by air, land, rail, or water, and suitable for multipurpose applications which require power in the range of 500 to 4000 kW(e). The system was designed to be capable of unattended remote operation and automatic startup and shutdown, and to be compatible with all terrestrial environments, either water or atmospheric. When the program was closed out in 1965, the SNAP 4 system had progressed through the conceptual and preliminary design stages, and work was starting on final design of a prototypic system. (auth)

23551 (AI-AEC-13072) DESIGN AND INTEGRATION OF ZIRCONIUM HYDRIDE REACTOR POWER SYSTEMS. Van Osdol, J. H. (ed.) (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-701. 208p. Dep. NTIS $7.60.

The SNAP Zirconium Hydride (ZrH) Reactor Program supported reactor and associated component development, system development, and a variety of application and integration studies. The key technical aspects of each of these components and subsystems are summarized. The technology status of each is presented. Operational characteristics of ZrH reactor systems are discussed. The application studies which were conducted are summarized. The components and subsystems presented are: reactor, shielding, various power conversion systems, heat rejection systems, liquid metal components, and support structure. The applications summarized are: lunar base, space station, space base, communications satellites, space shuttle integration, surveillance satellites, hardened missile bases, terrestrial power systems, and marine systems. (auth)

23552 (AI-AEC-13087) ZIRCONIUM HYDRIDE REACTOR CORE HYDRAULIC STUDIES: SUMMARY REPORT. Ostermier, B. J. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-701. 124p. Dep. NTIS $8.25.

A summary is presented for the series of water-hydraulic tests performed to evaluate the flow characteristics of the various zirconium hydride reactors. Test models, test methods, instrumentation, and results are described. Tests were conducted to develop inlet plenum configurations and fuel element fin configurations. Inlet plenum configurations were evaluated on their ability to produce desired in-core flow distributions, and to provide a uniform pressure at the inlet grid plate surface without any undesirable flow characteristics. A series of inlet plenum tests was also conducted to determine any flow behavior which might have contributed to the operational problems of the S8DR. Fuel element fin configurations were evaluated on their ability to produce interchannel flow mixing within the reactor core. Pressure drop determinations were made for all plenum and fuel element fin configurations. (auth)

23553 (AI-AEC-13090) SPACE NUCLEAR SYSTEM VOLUME ACCUMULATOR DEVELOPMENT: SUMMARY REPORT. Whitaker, W. D.; Shimazaki, T. T. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-701. 50p. (NASA-CR-121245). Dep. NTIS $4.50.

The engineering, design, and fabrication status of the volume accumulator units (VAU's) to be employed in the NaK primary and secondary coolant loops of the 5-kW(e) Reactor Thermoelectric System are described. Three identical VAU's are required—two for the primary coolant loop and one for the secondary coolant loop. The VAU's utilize nested-formed bellows as the flexing member, are hermetically sealed, provide double containment and utilize a combination of gas-pressure force and bellows-spring force to obtain the desired pressure regulation of the coolant loops. All parts of the VAU, except the NaK inlet tube, are to be fabricated from Inconel 718. (5 references) (auth)

23554 (AI-AEC-13094) VOLUME ACCUMULATOR DESIGN ANALYSIS COMPUTER CODES. Whitaker, W. D.; Shimazaki, T. T. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-701. 31p. (NASA-CR-121246). Dep. NTIS $3.75.

The computer codes, VANEP and VANES, were written and used to aid in the design and performance calculation of the Volume Accumulator Units (VAU's) for the 5-kW(e) Reactor Thermoelectric System. VANEP computes the VAU design which meets the primary coolant loop VAU volume and pressure performance requirements. VANES computes the performance of the VAU design, determined from the VANEP code, at the conditions of the secondary coolant loop. The codes can also compute the performance characteristics of the VAU's under conditions of possible modes of failure which still permit continued system operation. (auth)

23555 (GKSS-72/E/25) N. S. "OTTO HAHN": CONTRIBUTIONS TO AN ENVIRONMENTAL INVESTIGATION ON BOARD DURING VOYAGE NO. 37 FROM DECEMBER 2–19, 1969. Research Report No. 19. Herrmann, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 64p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Ambient conditions on board the N. S. "Otto Hahn" were studied during the test and research voyage No. 37 in the waters off the Canaries from December 2–19, 1969. Most of the investigations are concerned with noise recording and phonometric measurements in the various spaces and rooms of the ship as well as with the lighting conditions on board and with microclimatic aspects. The methods and results and the conclusions to be drawn from these investigations with respect to the living and working conditions of the crew are summarized. (GE)

23556 (GKSS-72-E-29) N. S. OTTO HAHN TEST REPORT NO. 20. Cargo and Research Trip (Voyages No. 76-79) During the Period from 15 May to 4 September 1972 to Rio de Janeiro, Casablanca and Monrovia. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 44p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

The voyage reports are supplemented by various power histories. Measurements carried out during the voyages are included. Measurements concerning the natural convection in the FDR are of special interest. These voyages conclude the final operating period of the first reactor core. (GE)

23557 (IFA-FR-103-1973) PULSED NUCLEAR REACTOR AND HEAT ENGINE IN A SINGLE UNIT. Essay on the Direct Conversion of the Nuclear Energy Into Mechanical Energy. Cristea, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

Design parameters are presented for gas fueled pulsed reactors which are arranged in horizontal alignment and which are pulsed by a reciprocating piston between the reactors. (DCC)

23558 (LA-3785) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1967). Los Alamos Scientific Lab., N. Mex.). Sep 1967. Contract W-7405-eng-36. 58p. Dep. NTIS $5.00.

Declassified 29 Aug 1973.

Information is presented concerning Phoebus 1B test results, Phoebus 2 test operation, Phoebus 2A design parameters and neutronics, Pewee 1 neutronics and components, testing of pyrolytic carbon coated UC_2 fuel particles, and mechanical properties of graphite. (DCC)

23559 (LA-3962) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING MAY 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Jun 1968. Contract W-7405-eng-36. 83p. Dep. NTIS $6.25.

Declassified 29 Aug 1973.

Information is presented concerning Phoebus 2A test results and design changes, Pewee 1 design parameters and neutronics, Pewee 2 neutronics, testing of pyrolytic carbon coated UC_2 fuel particles, fabrication and mechanical properties of graphite, and fabrication and mechanical properties of UC−ZrC fuel elements. (DCC)

23560 (LA-4012) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Sep 1968. Contract W-7405-eng-36. 81p. Dep. NTIS $6.25.

Declassified 29 Aug 1973.

Information is presented concerning Phoebus 2A test results and equipment, Pewee 1 design parameters and component fabrication, Pewee 2 testing and component fabrication, Nuclear Furnace Reactor design features, corrosion testing of pyrolytic carbon coated UC_2 fuel particles, mechanical properties of graphite, and mechanical properties of UC−ZrC fuel elements. (DCC)

23561 (LA-4854) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR THE PERIOD ENDING NOVEMBER 30, 1971. (Los Alamos Scientific Lab., N. Mex.). Dec 1971. Contract W-7405-eng-36. 54p. Dep. NTIS $4.75.

Declassified 29 Aug 1973.

Information is presented concerning Pewee 3 neutronics and component testing, Nuclear Furnace Reactor neutronics and testing, fabrication of UC−ZrC fuel elements, and fabrication and testing of ZrC coated fuel particles. (DCC)

23562 (N-73-11705) ADVANCED MISSION APPLICATIONS OF NUCLEAR ELECTRIC PROPULSION. Spadoni, D. J. (IIT Research Inst., Chicago, ILL). Jul 1972. Contract NASw-2144. 52p. (NASA-CR-129134). NTIS.

Current analysis of advanced unmanned planetary missions in the 1980's and beyond indicate the need for propulsion systems with performance capabilities beyond those of current and near state-of-art. One propulsion system concept being considered to fill this need is nuclear electric low thrust propulsion (NEP). Two different NEP system power levels are considered for performance analysis: 100 kW and 250 kW. The 100 kW NEP system uses a Centaur(D-1T) chemical stage for injection to an interplanetary transfer and the 250 kW system uses a spiral escape maneuver. Performance comparison is in general made on the basis of net payload at the target as a function of flight time. NEP performance is shown for unconstrained and constrained (20,000 hours) thrusting time. Specific impulse is optimized and ranges from 4000 sec to 7000 sec. (auth)

23563 (N-73-18676) PRELIMINARY NEUTRONIC ANALYSIS OF A CAVITY TEST REACTOR. Whitmarsh, C. L. Jr. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1973. 32p. (NASA-TMX-2743). NTIS.

A reference configuration was calculated for a cavity test reactor to be used for testing the gas core nuclear rocket concept. A thermal flux of 4.1×10^{14} n/cm^3 sec in the cavity was provided by a driver fuel loading of 6.4 kg of enriched uranium in MTR fuel elements. The reactor was moderated and cooled by heavy water and reflected with 25.4 cm of beryllium. Power generation of 41.3 MW in the driver fuel is rejected to a heat sink. Design effort was directed toward minimization of driver power while maintaining 2.7 MW in the cavity during a test run. Ancillary data on material reactivity worths, reactivity coefficients, flux spectra, and power distributions are reported. (auth)

23564 NUCLEAR PROPULSIVE MODULE: ITS POWER LIMITATIONS. D'Elia, G. (Univ., Naples). Termotecnica (Milan); 27: No. 3, 118-126(Mar 1973). (In Italian).

The design of the nuclear propulsive module Phoebus-2 actually under development by NASA and AEC, is described. Engine thrust level of the Marshall Center, USA, is 230,000 lb or 5000 MW(t). Its weight agrees with the launch-possibilities of an uprated Saturn-V rocket. The nuclear engine rocket has intrinsic power limitations. Such limitations are defined on the basis of the hypotheses as ideal work conditions of the reactor and assuming that the thermal problem is the most important. (auth)

23565 ITR-DEVELOPMENT IS SUSPENDED. Minister von Dohnanyi Announces Principles for Project Control. Inform. Bild. Wiss.; No. 9, 123-124(1972). (In German).

The development of the incore-thermionic-reactor (ITR) (small reactor for the energy supply of satellites) was stopped on the 1st September 1972 by the minister of education and science. The decision was made following the consultation with science and economy specialists. 46 million DM have been spent. The development work should have a meaningful end and the results should be documented so as to be of use at all times. (GE)

23566 SHIELDING CONCRETE WITH PREPAKT METHOD FOR THE FIRST NUCLEAR POWERED SHIP. Hisatomi, Y.; Horiguchi, H.; Tatebe, M.; Takata, H. (Shimizu Construction Co. Ltd., Tokyo). Shimizu Kensetsu Kenkyusho-Ho; No. 17, 45-67 (Apr 1971). (In Japanese).

Details are given of the construction of the shielding concrete for the first nuclear powered ship in Japan, which involves research stages before the commencement of the project, and application of the results to the works in situ. As the shielding concrete was to be placed with prepakt method into the structure of the ship, the following tests were required as part of the research: 1) Determination of the concrete mixture for nine densities of the concrete. 2) Establishment of the system to confirm each specified density during the work. 3) Method to eliminate internal failure of the concrete. 4) Establishment of the working specification. 5) Measurement of the prepakt concrete pressure against the structure of the ship. (auth)

23567 THERMIONIC REACTOR POWER SYSTEMS. Gietzen, A. J.; Homeyer, W. G. (Gulf General Atomic Co., San Diego, CA). pp 556-558 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Thermionic power systems have been designed for a variety of space applications. Studies have included both manned and unmanned applications for auxiliary power and electrical propulsion. Specific systems reported for auxiliary power include 5 to 10 kW(e) for unmanned satellites, 40 kW(e) for manned space laboratories, and a 120 kW(e) system for electric propulsion. All of these systems employ the same basic thermionic fuel element. The systems studied, performance summaries, types of applications considered, design guidelines and constraints, and the objectives to be met are discussed. (auth)

23568 ZIRCONIUM HYDRIDE SPACE POWER REACTOR DESIGN. Asquith, J. G. (Atomics International, Canoga Park, CA); Mason, D. G.; Stamp, S. pp 572-580 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The Zirconium Hydride Space Power Reactor being designed and fabricated is intended for a wide range of potential applications. Throughout the program a series of reactor designs have been evaluated to establish the unique requirements imposed by coupling with various power conversion systems and for specific applications. Current design and development emphasis is upon a 100 kW(t) reactor for application in a 5 kW(e) thermoelectric space power generating system, which is scheduled to be fabricated and ground tested in the mid 70's. The reactor design considerations reviewed are discussed in the context of this 100 kW(t) reactor and a 300 kW(t) reactor previously designed for larger power demand applications. (auth)

23569 THERMIONIC REACTOR PROGRAM: AN OVERVIEW. Beard D. S.; Lynch, J. J. (Atomic Energy Commission, Washington, DC). pp 1036-1040 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The AEC/NASA thermionic reactor program is reviewed with emphasis on the latest progress in this technology. The possible applications for utilization of thermionic reactors are reviewed and the joint AEC/NASA program approach to demonstrate thermionic technology is outlined. The thermionic reactor technology programs of France, Germany, and the Soviet Union are highlighted. (auth)

23570 DEVELOPMENTAL STATUS OF THERMIONIC MATERIALS. Yang, L.; Chin, J. (Gulf General Atomic, San Diego,

CA). pp 1041-1049 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Reference materials selected for the major components of the unit cell of a thermionic fuel element are described. Out-of-pile and in-pile evaluation results are given. Current efforts for improving the life and performance of thermionic fuel element are outlined. (auth)

23571 THERMIONIC FUEL ELEMENT DEVELOPMENT STATUS SUMMARY. Holland, J. W. (Gulf General Atomic Co., San Diego, CA). pp 1060-1065 of 7th Intersociety Energy Conversion Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Operating and environmental requirements of the thermionic fuel element (TFE) under development for the AEC is summarized for the various space applications of in-core thermionic reactor power plants. The approach and program milestones for TFE development are briefly reviewed followed by a description of the key technologies under study. Technology status is compared to the requirements of the various applications. (auth)

23572 80,000-SHP CONTAINERSHIP WITH NUCLEAR PROPULSION. Schiff, A.; Ulken, D. Schiff Hafen; 24: No. 11, 1-4 (Nov 1973). (In German). (GKSS-73/E/4).

Economic feasibility studies of container ships with nuclear propulsion were conducted by a German–Japanese team. Presently available data did not allow a final decision for a large-scale nuclear fleet. One or several demonstration ships should be built first with financial support by the governments. Competitive nuclear ships were expected to be available toward the end of the 1970s. The German version was presented with respect to dimensions, collision protection, engines, building costs, operating costs and financing. The 220 MW/th reactor was designed as an advanced version of that in the Otto Hahn, as a pressure water reactor with an integrated arrangement of pumps and heat exchanger in the reactor pressure vessel. (HBG)

23573 RADIOLOGICAL PROTECTION IN THE ROYAL NAVY. Fallowfield, T. L. (Ministry of Defence, London). Radiol. Prot. Bull.; No. 4, 9-12(Jul 1973).

A brief outline is sketched of the Ministry of Defence (Navy) organization for dealing with nuclear safety and radiological protection in submarine propulsion and research reactors. It is stated that although Crown exemptions apply to the various acts relating to ionizing radiation and radioactive materials, it is the MOD(N) policy to comply with the regulations, differences from civil practices arising only from reporting and administration. Particular reference is made to the organization at the refitting yards and repair bases, and to the duties of the Naval Radiological Protection Service. (UK)

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Refer also to abstracts 20744, 20861, 21072, 21652, and 22127.

23574 (AD-759118) ANALYSIS OF MH-1A LOSS OF COOLANT. Final Report. Gignilliat, H. C.; Johnson, G.; Franson, J. D.; Terpolilli, P. M. (Army Engineer Reactors Group, Fort Belvoir, VA. Engineering Div.). 9 Nov 1972. 125p. (ED-7212). NTIS.

Analyses of a postulated loss of coolant accident (LOCA) for the MH-1A Nuclear Power Plant are presented for large and intermediate size breaks in the primary system. Methods and assumptions consistent with AEC Interim Acceptance Criteria were used in evaluating the performance of the Emergency Core Cooling Systen (ECCS). The computer codes RELAP-3 for reactor system blowdown and THETA1-B for fuel element heatup were used to perform these calculations at a core power of 49.5 MW (t). The results of the core temperature transient for various break conditions are presented and the required cooling capability of a system meeting the AEC interim criteria is discussed. (auth)

23575 (AE-475) SURVEY OF APPLIED INSTRUMENT SYSTEMS FOR USE WITH LIGHT WATER REACTOR CONTAINMENTS. Tuxen-Meyer, H. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jun 1973. 20p. Dep. NTIS $3.00.

Data concerning the instrumentation, testing practices and monitoring procedures relating to BWR and PWR containment atmospheres are tabulated. Questionnaires were submitted to a representative selection of reactor users in the USA, West Germany and Sweden who had either recently started operation or were on the point of taking delivery of new plant. Compilation of the answers in table form reveals surprising differences between the different instrument arrays as regards the design criteria employed and the technical solutions to which these lead. One consequence of the survey is to indicate the need for further information regarding instrumentation philosophy. This is demonstrated in the next to the last section of the report with a new series of questions. (auth)

23576 (AECL-4504) SYMPTOMS AND RECOGNITION OF WATER TREATMENT PROBLEMS IN THERMAL AND NUCLEAR POWER STATIONS: CONTROL OF RADIOACTIVE BUILD-UP. Hemmings, R. L. (Atomic Energy of Canada Ltd., Sheridan Park (Ontario)). Apr 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

Build-up of radioactive materials in nuclear power stations must be controlled to prevent excessive exposure of men to radiation and to allow routine maintenance of equipment. Techniques have been developed to detect radiation build-up early in the life of a station, and to control it at minimum possible levels. (auth)

23577 (CEA-N-1612) RAPID METHOD FOR CALCULATING THE NEUTRON SPECTRA IN THE CASE OF A CRITICALITY ACCIDENT (CARNAC PROGRAM). Bessis, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1973. 52p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

The method of calculation presented is extremely fast but gives only approximate results. The first part (CRITIC program), which is based on the FERMI age theory, is used to evaluate the number of neutrons emitted by a moderated critical assembly as well as their energy spectrum. The second part (NARCISSE program), which uses the concrete albedo, is employed to evaluate the effect of the reflection of neutrons by the walls and to determine the resultant flux at any given point together with the distribution in 21 energy groups. The results obtained compare favorably with those obtained using a Monte-Carlo program. (FR)

23578 (COO-2152-8) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATION. Quarterly Progress Report, April 1–June 30, 1973. (Cincinnati Univ., Ohio. Dept. of Chemical and Nuclear Engineering). 1973. Contract AT(11-1)-2152. 10p. Dep. NTIS $3.00.

Pressure drop and heat transfer phenomena of importance during a loss of coolant accident are studied with three experiments: (a) Transient Pressure Drop Investigation; (b) Two Phase Pressure Drop and Flow Pattern Study; and (c) Transition Boiling and Reflooding Heat Transfer Tests. (auth)

23579 (DP-MS-72-57) DEFENSE-IN-DEPTH IN REACTOR SAFETY. Mirshak, S. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 25p. (CONF-730217-3). Dep. NTIS $3.25.

From symposium on the principles and standards of reactor safety; Julich, F.R. Germany (5 Feb 1973).

The system to ensure continuing safety in the large reactors at the Savannah River Plant is based on defense-in-depth in all phases of operation: the organization of skilled technicians, theorists, and operating personnel; effective administrative controls and procedures; safety limits; and engineered safety features. The lines of defense are delineated and maintained by procedural control. Reactor safety is still a top priority consideration at Savannah River after almost 20 years of reactor operation. A vital part of reactor safety at Savannah River is continuing experimental and theoretical analyses to understand more fully the mechanism of response of the reactor processes to postulated abnormal conditions. Detailed analyses of postulated accidents and reactor response are defined for cases up to and including the highly unlikely melting of a full core. This fuller understanding has resulted in improved procedures, new operating limits for protection against postulated reactor transients, new safety equipment including on-line computers, and improvement of protective systems. These improvements provide an additional margin of safety, both by reducing the probability of postulated accidents and by mitigating the consequences should accidents occur. 2 references. (auth)

23580 (DP-MS-73-4) SPACE-DEPENDENT TRANSIENT REACTOR EXPERIMENTS AND CALCULATIONS AT THE SAVANNAH RIVER LABORATORY. Dodds, H. L.; Parks, P. B.; Bailey, C. E.; Baumann, N. P.; Currie, R. L.; Stewart, J. W. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab). [nd]. Contract AT(07-2)-1. 26p. (CONF-730611-14). Dep. NTIS $3.50.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

The reactor safety program at Savannah River includes, among other items, the development of suitable codes capable of comput-

ing the space-dependent transients that arise under postulated accident conditions. The codes developed for the neutron kinetics part of the calculation use space and time dependent diffusion theory. Experiments to provide base data against which various spatially dependent transient codes can be checked are described. Such codes have been developed at other sites as well as at Savannah River, and they use differing calculational methods. (auth)

23581 (HEDL-TME-73-53) MEASUREMENT ERROR AND POTENTIAL ADMINISTRATIVE CONTROL FAILURES IN FABRICATION OF FFTF FUEL. Ripfel, H. C. F.; Strand, C. A.; Johnston, J. W. (Hanford Engineering Development Lab., Richland, Wash.). May 1973. Contract (AT(45-1)-2170. 52p. AT.

A statistical study was made to determine the probability of fabricating FFTF fuel overenriched in fissile content–an important consideration in the operation and safety of the reactor. By use of error propagation methods, the uncertainties that relate to existing and predicted measuring capabilities in conjunction with administrative controls were evaluated. From the detailed data established for each phase of fabrication and assembly, the major conclusions were: the average grams fissile per FFTF fuel pin will be within 1% of nominal, at the 95% confidence level; and the standard deviations on total fissile content of the core range from 0.2% to 0.005%, depending on the measurement point considered. (auth)

23582 (INIS-mf-660/9) HYBRID COMPUTER MODEL FOR THE LOSS-OF-COOLANT ACCIDENT IN PRESSURIZED WATER REACTORS. Maslo, R. M. (Electronics Associates Inc., Long Branch, NJ); Nahavandi, A. N. 1972. 11p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The current analytical techniques, for the prediction of the plant dynamic behavior during a loss-of-coolant accident in pressurized water reactors, are inadequate. More sophisticated approaches, needed for the plant safety evaluation, require a prohibitively large amount of digital computer storage and running time. A hybrid (digital-analog) computer technique as a means for improving the computational efficiency for the solution of the loss-of-coolant accident problem is introduced. (INIS)

23583 (IRS-F-14) REPORTS ON THE RESEARCH PROJECTS IN THE FIELD OF REACTOR SAFETY PROMOTED BY THE FEDERAL MINISTRY FOR RESEARCH AND TECHNOLOGY. Quarterly Report, October 1–December 31, 1972. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Jun 1973. 133p. (In German). Dep. NTIS (U. S. Sales Only) $8.75.

Brief summaries are presented on progress in reactor safety research programs conducted in the German Federal Republic during October to December 1972. (DCC)

23584 (KFK-1787) 2. SEMI-ANNUAL REPORT, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1973. 105p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

The progress achieved in the activities of the Nuclear Safety Project in the second half of 1972 is described. The following topics are discussed: the development of iodine filters for use in recirculating post-accident filter systems in reactors and in off-gas cleaning systems of reprocessing plants; the release, transport and deposition of radioactive contamination in primary reactor circuits and their decontamination; measurements of the tritium contamination in rainwater, surface, underground and drinking water in the region between Mannheim and Kehl; project studies for the development of a krypton-85 removal system; investigations for assessing the long-term radiological impact of nuclear facilities by accumulation of nuclear facilities in defined regions; measurements of the dynamic stresses of BWR pressure suppression systems as part of the safety experiments in the reactor Marviken, Sweden; a state of the art study of the ECCS situation of LWR's in the USA as well as investigations of the fuel rod failure mechanisms and its consequences upon the effectiveness of the ECCS; establishment of a research program covering topics of the core melt-down accident; completion of a state of the art study analysing the mechanisms involved in cleaning the post-accident atmosphere within the LWR containment; theoretical and experimental investigations of the time-dependent atmospheric transport mechanisms of radioactive pollutants in the environment of nuclear facilities; criteria to provide measures for the protection of the population in the hypothetical case of severe accidents; and implementation of a prototype for the Reactor Safety Information System (RESI) in order to demonstrate the feasibility of the system concept. (GE)

23585 (KFK-1800) ACTIVITY INVENTORY IN THE POST ACCIDENT ATMOSPHERE OF A LIGHT WATER REACTOR (LWR) CONTAINMENT. Survey and State of Knowledge. Hosemann, J. P.; Jordan, H.; Schikarski, W.; Wild, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Jun 1973. 104p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

The activity inventory of a 1,000 megawatt light water reactor (LWR) is calculated. A review is given of the known attenuation processes that contribute to a reduction of airborne activity in the reactor containment after a hypothetical accident. The calculation of the activity present at the time of the accident differentiates between fuel, bred fuel, fission products, activated structural material and activated coolant. Extensive lists of radionuclides, ordered according to a measure of their radiotoxicological importance, are set up. This review of the literature on attenuation processes reveals that the theoretical understanding of nearly all relevant elementary processes is incomplete. Particular importance is therefore attached to experimental findings. Nevertheless, a number of models that encompass several elementary processes judged most important have been developed and compared to large scale experiments that simulate post-accident containment behaviour. (GE)

23586 (MRR-117) HYDROGEN PRODUCTION IN CONTAINMENT AFTER A LOSS-OF-COOLANT ACCIDENT IN LIGHT-WATER REACTORS. Jahn, H. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Mar 1973. 58p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

The problem of hydrogen- and oxygen production after a loss-of-coolant accident is discussed. The radiochemical process, which is called radiolysis, leads to a decomposition of the coolant and to a time-dependent rise in the H_2–O_2 mixture within the containment. Because the safety guides indicate that a conservative combustion rate is 4% vol, it is necessary to deal with considerations which are described. A short general review of this problem is given. A short explanation is given of the computer code RADI 1, developed at the LRA, and some curves of important parameters and results are included. (GE)

23587 (NP-19766) RESEARCH WORKS ON THE REACTOR SAFETY IN JAPAN. (Science and Technology Agency, Tokyo (Japan). Atomic Energy Bureau). Dec 1972. 81p. Dep. NTIS (U. S. Sales Only) $6.25.

Information on reactor safety research programs in Japan is presented concerning loss of coolant accidents including ROSA test program, FUGEN ECCS test program, and NSRR test program; loss of coolant accident analysis for JATR; heavy section steel technology; and leak rate test for PWR steam relief valve. (DCC)

23588 (PTB-FMRB-45) RADIATION PROTECTION AT THE BRAUNSCHWEIG RESEARCH AND TESTING REACTOR (FMRB) OF THE GOVERNMENT PHYSICAL TECHNICAL FACILITY. Kriks, H. J.; Rasp, W.; Siegel, V. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Feb 1973. 49p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

Radiation protection service, radiation protection monitoring, special radiation protection measurements, environmental monitoring, precautionary measures for incidents and emergency cases, and bookkeeping and supervision are reported. (GE)

23589 (SGAE-2128) EVALUATION OF THE SAFETY OF LIGHT WATER REACTORS WITH THE AID OF THE "METHOD OF BARRIERS." Kamelander, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G. M. B. H., Seibersdorf. Institut fuer Reaktortechnik). May 1973. 34p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

A brief discussion of the current safety philosophies is related. The "method of barriers" developed at "Commissariat a l'Energie Atomique" is explained in detail. Using this method,, general directions for the presentation of an accident catalogue are established. To illustrate the execution of the reactor analysis accident, the treatment of the rod ejection accident is given. (auth)

23590 (SLA-73-744) DYNAMIC RESPONSE OF A REACTOR FLOW TUBE TO A POTENTIAL ACCIDENT SITUATION. Lawrence, R. J.; Bertholf, L. D.; Karnes, C. H.; Lundergan, C. D. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 26p. Dep. NTIS $3.00.

The results of calculations performed to determine the response of a long in-core flow tube when subjected to large dynamic axial loads in a potential accident situation in the Advanced Test Reactor are presented. A one-dimensional model of the system is generated, and finite difference, Lagrangian techniques are used to calculate the detailed dynamic response to the tube. (auth)

23591 (UCRL-51408) CONCEPT FOR UNDERGROUND SITING OF NUCLEAR POWER REACTORS. Blake, A.; Karpenko,

V. N.; McCauley, E. W.; Walter, C. E. (California Univ., Livermore. Lawrence Livermore Lab.). May 1973. Contract W-7405-eng-48. 28p. Dep. NTIS $4.00.

Preliminary design criteria developed for a general case show that underground siting of nuclear power reactors is practicable and safe. The concept calls for open-pit excavation to allow construction of the reactor containment structure in nearly any geological medium, although some attention must be given to local ground-water conditions. The required depth of excavation for the structure housing the nuclear system and steam generators is about 300 ft. After being constructed in the pit, this structure is covered with selected backfill material. The backfill is chosen for its well-defined low permeability so that it will confine within a small envelope any radioactivity release that might result from a rupture of the containment structure. The additional cost of putting the nuclear portion of the system underground is only a small fraction of the cost of a conventional all-surface nuclear power plant. The turbine/generator sets should be located at or near the surface for minimum capital expenditure and operating cost. Underground reactor siting as proposed herein will apparently require no new technology. An extensive body of relevant experience provides confidence that radioactive material can be confined under the conditions of a reactor accident. (auth)

23592 (WASH-1258(Vol.1)) FINAL ENVIRONMENTAL STATEMENT CONCERNING PROPOSED RULE MAKING ACTION; NUMERICAL GUIDES FOR DESIGN OBJECTIVES AND LIMITING CONDITIONS FOR OPERATION TO MEET THE CRITERION AS LOW AS PRACTICABLE FOR RADIOACTIVE MATERIAL IN LIGHT-WATER-COOLED NUCLEAR POWER REACTOR EFFLUENTS. Volume 1. The Statement. (Directorate of Regulatory Standards (AEC), Washington, D. C.). Jul 1973. 625p. Dep. NTIS $13.60.

The adoption of numerical guides specified in the proposed Appendix I dated June 9, 1971 for design objectives and limiting conditions for operation to meet the criterion "as low as practicable" for radioactive material in light-water-cooled nuclear power reactor effluents was proposed. This action provides numerical guidance on design objectives and limiting conditions of operation to assist applicants for and holders of licenses for light-water-cooled power reactors in meeting the requirements set forth in Sections 20.1(c), 50.34a and 50.36a of the Commission's regulations that radioactive material in effluents released from those facilities to unrestricted areas be kept "as low as practicable." The expected result of this action is that: total-body doses to individuals living near the site boundary of nuclear power stations due to radioactive material in effluents from those facilities will be less than about 5 millirem per year (about 5 percent of doses from natural background radiation); annual doses to sizable population groups from radioactive material released in effluents from all light-water-cooled nuclear power reactors on all sites in the United States through the year 2000 will be less than about 1 millirem per year (about 1 percent of doses from natural background radiation); and there will be no demonstrable biological effects to aquatic or terrestrial organisms from exposures to the radioactive material in the effluents from light-water-cooled nuclear power reactors. The alternatives considered were to: defer issuance of any numerical guidelines; modify the proposed Appendix I to provide for guidelines below the 5 millirem per year value; modify the proposed Appendix I to provide for guidelines higher than 5 millirem per year value; modify the proposed Appendix I to eliminate Sections IIA and IIB (Quantity, Concentrations, and Dose Rates in the Environment); and modify the proposed Appendix I to provide guidelines on dose to the total population. The cost-benefit analyses indicate that it appears feasible to attain the design objective of 5 millirem per year to any organ of an individual offsite from radioactive material in liquid effluents. It appears feasible to attain the design objective of 5 millirem per year to the total body from radioactive material in gaseous effluents, but for individual organs (i.e., thyroid and skin) the design objective of 5 millirem per year may not be practicable with existing technology. An alternative design objective of 15 millirem per year for radioactive material in gaseous effluents for single organs is discussed. Volume 1 is concerned with source terms for releases of radioactive materials in gaseous and liquid effluents; cost of radwaste treatment; projected nuclear power requirements; radiation dose and the risk of biological effects; bases for analysis and evaluation; cost benefit analysis; and additional considerations of radioiodine. (FS)

23593 (WASH-1258(Vol.2)) FINAL ENVIRONMENTAL STATEMENT CONCERNING PROPOSED RULE MAKING ACTION; NUMERICAL GUIDES FOR DESIGN OBJECTIVES AND LIMITING CONDITIONS FOR OPERATION TO MEET THE CRITERION AS LOW AS PRACTICABLE FOR RADIOACTIVE MATERIAL IN LIGHT-WATER-COOLED NUCLEAR POWER REACTOR EFFLUENTS. Volume 2. Analytical Models and Calculations. (Directorate of Regulatory Standards (AEC), Washington, D. C.). Jul 1973. 450p. Dep NTIS $10.60.

23594 (WASH-1258(Vol.3)) FINAL ENVIRONMENTAL STATEMENT CONCERNING PROPOSED RULE MAKING ACTION; NUMERICAL GUIDES FOR DESIGN OBJECTIVES AND LIMITING CONDITIONS FOR OPERATION TO MEET THE CRITERION AS LOW AS PRACTICABLE FOR RADIOACTIVE MATERIAL IN LIGHT-WATER-COOLED NUCLEAR POWER REACTOR EFFLUENTS. Volume 3. Comments on the Draft Environmental Statement and Staff Responses Thereto. (Directorate of Regulatory Standards (AEC), Washington, D. C.). Jul 1973. 332p. Dep. NTIS $10.60.

23595 NUCLEAR FUEL DEBRIS RETENTION STRUCTURE. Synder, H. J. Jr.; Guenther, R. W. (to United States Atomic Energy Commission). U. S. Patent 3,719,556. 6 Mar 1973. Filed date 2 Dec 1971. 8p.

A nuclear fuel debris retention structure which accommodates the dispersion, collection and cooling of the fuel debris resulting from a nuclear accident is described. The structure includes features which: (1) provides for the disbursement of fuel debris by expulsion action of entrapped sodium, (2) provides all-around cooling for chunks of debris, (3) provides for radial disbursement by the contour and direction of the grid vanes, (4) provides separate cooling to the primary structural support, and (5) allows for the accumulation of finer debris and molten materials due to the shape of the grids. (Official Gazette)

23596 METHOD OF SUPPRESSING THE FORMATION OF METHYL IODIDE IN A WATER-COOLED NUCLEAR REACTOR. Slagle, W. L. (to United States Atomic Energy Commission). U. S. Patent 3,734,826. 22 May 1973. Filed date 20 Jul 1972. 4p.

Release of methyl iodide to the environment following a major loss-of-coolant accident in which significant core meltdown occurs is prevented by suppressing its formation rather than by reducing its concentration after it has been formed. This is accomplished by injecting a large excess of a material which is more reactive to methyl radicals than is iodine, such as chlorine or fluorine, into the reactor plenum and, if desired, into the reactor containment vessel immediately upon occurrence of a major loss-of-coolant accident. Preferably, the chlorine injection system is activated the same time as the emergency core cooling system. (Official Gazette)

23597 SCAVENGERS FOR RADIOACTIVE IODINE. Cremeans, G. E.; Berry, D. A.; Rosenberg, H. S.; Genco, J. M.; Morrison, D. L. (to United States Atomic Energy Commission). U. S. Patent 3,730,833. 1 May 1973. Filed date 17 May 1971. 10p.

A surface coating for absorbing radioactive vapor-phase iodine and radioactive vapor-phase methyl iodide to be applied to the inside of a containment vessel for a water-cooled power reactor is described. The active ingredients of the surface coating may be polyacrylamines and combinations of polyacrylamines and amine-terminated polyamides. The active polymer ingredients are cross-linked to provide the physical characteristics necessary to withstand the environmental conditions present in a containment vessel subsequent to a loss-of-coolant accident. (Official Gazette)

23598 ASEISMIC DESIGN OF SWITCHGEAR AND INSTRUMENTATION FOR NUCLEAR POWER STATIONS. Zamoto, A.; Takamatsu, S.; Kasai, N.; Koyama, H.; Endo, Y. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 28: No. 5, 540-545(May 1973). (In Japanese).

Consideration of safety is increasing in importance for nuclear stations, including the demand for aseismic design of switchgear and instrumentation. To meet these demands, a series of aseismic design experiments have been conducted in Toshiba, with results satisfying aseismic conditions. (auth)

23599 SAFETY IN THE INSTALLATION OF A REACTOR IN OOI NUCLEAR POWER PLANT OF KANSAI ELECTRIC POWER COMPANY. (Atomic Energy Commission, Tokyo). Genshiryoku Iinkai Geppo; 17: No. 6, 15-24(Jun 1972).

The investigation concerning the safety in the installation of a reactor in Ooi nuclear plant of Kansai Electric Power Company is reported. Conditions of siting and an outline of the nuclear plant were inspected. Safety design and safety countermeasures were investigated for nuclear-thermal design and dynamic characteristics, nuclear fuel, measurement and control systems, containment vessel, cooling systems, fuel handling equipment, disposal establishments for radioactive waste, radiation control, prevention of release of radioactive materials, and safety and protection equipment. The mean exposure dose under normal operation was estimated. Reactivity accidents and mechanical accidents which might occur were inspected and countermeasures to these acci-

dents were investigated. Consequences due to serious and hypothetical accidents were estimated. The technical capacity of Kansai Electric Power Company was investigated. As a result, it was judged that regarding this reactor, enough safety would be ensured both under the normal operation and in any accident. (JA)

23600 PRINCIPAL QUESTIONS OF WATER MANAGEMENT CONCERNING THE PROPOSED SITING OF NUCLEAR POWER REACTORS IN THE LAND OF NORTH RHINE-WESTFALIA. Paetze, D. (Landesanstalt fuer Gewaesserkunde und Gewaesserschutz Nordrhein-Westfalen, Krefeld, Ger.). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

Nuclear power reactors still need receiving waters with a sufficient run-off for the discharge of their cooling-water and their liquid radioactive waste. The absorption capacity of these surface waters is limited by its further exploitation, e.g. the extraction of drinking-water and wastewater and the discharge of domestic and industrial sewage. By means of examples it is shown for the Land of North Rhine-Westphalia how changes in temperature, oxygen capacity and biological effects of waters caused by a concentrated introduction of large quantities of thermal pollution can determine the siting of the power reactors and the distance from each other. As the time of flow of rivers is low in comparison to the halflife of the radionuclides emitted by nuclear power reactors, the site of a nuclear power reactor on a system of fresh water cannot be regarded as isolated. The irradiation that a human being can receive through the exploitation of waters must be estimated from the possible total pollution and it probably will limit the number of nuclear power reactors which can be erected at certain receiving waters. Calculations of the absorption capacity will allow an early coordination of the interests of water management with those of the power industry, which will make its plans for new sites according to the expected consumption. This coordination will be especially necessary in the densely populated areas on the rivers Rhine and Ruhr, where the available water resources are limited. (GE)

23601 INFORMATION SYSTEM ON REACTOR SAFETY. Schlechtendahl, E. G.; Schultheiss, G. F.; Smidt, D. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The project "Reactor Safety Information System (RESI)" concentrates on the problems of completeness and reliability of the information which is generated and used in the course of a licensing process. The goal of the project is to provide methods for improved retrieval of this information. After discussion of this project with the various groups which are involved in reactor licensing in the FRG, the two following targets have been established: on the basis of a systems analysis of the licensing process and its information related aspects, a concept for an integrated information system is to be developed; and practical experience has still to be won with RESI of reduced scope and has meanwhile been gained. (GE)

23602 SAFETY ORGANIZATION AND PROCEDURES OF THE CENTRAL ELECTRICITY GENERATING BOARD. Harrison, J. R. (Central Electricity Generating Board, London). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The Central Electricity Generating Board in the U.K. is responsible for the generation and high voltage distribution of electricity in England and Wales. The system's total capacity at the present time is 55,000 MW, of which 3,250 MW is generated by nuclear stations, and it is planned to increase the nuclear capacity to 8,500 MW over the next three years. In the Board over 100 reactor years of operation have been accumulated, during which period safe operation has been maintained. The organization in the Board to ensure as far as possible the safety of its nuclear plant is described. The in-line executive control and the advisory/executive role of Board Departments which have particular interest in nuclear safety are discussed. The application of required safety standards via the organization of a nuclear station is described. Information is included on the role of organizations external to the C.E.G.B., as interpreted by the Board, with particular reference to the regulatory body, the authorizing Ministries and the U.K.A.E.A. Some discussion is included of the organization requirements for the safety assessment during design and construction of nuclear stations. (GE)

23603 STUDY PROGRAM OF THE CEA IN THE FIELD OF NONDESTRUCTIVE TESTING IN REACTOR SAFETY. Barrachin, B. (CEN de Saclay, Gif-sur-Yvette, France); Prot, A.; Chretien; Saglio, M.; Roche, R.; Tomachevskii, M. (1973). vp. (In French).

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

CEA program is described concerning: improvement of ultrasonic testing for in-service inspections, developments in acoustic emission testing, acoustic holography, and improvements of the quality of radiographic images. (GE)

23604 EMERGENCY DEPRESSURIZATION AND COOLING OF THE OMEGA AND PHEBUS LOOPS. Fonteray, J. (CEN de Saclay, Gif-sur-Yvette, France); Bailly, J.; Peltier, J.; Courtaud, M. (1973). vp. (In French).

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The out-of-pile loop OMEGA (CENG), which has a capacity of 4 MW can be used for carrying out tests on a cluster of 36 rods of actual length and for studying the laws governing heat transfer coefficients during depressurization of LWRs. This loop will be used in an effort to reproduce, within the limits of the testing section, boundary conditions similar to those observed within the limits of a fuel element in a pressurized or BWR core during depressurization. The in-pile loop PHEBUS (CENG) with a capacity of approximately 700 KW, is intended to be used to reproduce the behavior of LWR fuel under depressurization conditions. This loop is to be installed in the CABRI reactor. Tests will also be made involving rewetting of the element by different methods and to compare them from the point of view of efficiency. (GE)

23605 PROBLEMS OF NUCLEAR POWER PLANT ENGINEERING. Mazzoleni, F. Calore; 43: No. 5, 227-233(1972). (In Italian).

A general survey of the more interesting problems concerning the relationships between nuclear plants and environment is presented. The primary importance of the analysis of all possible accidents, evaluation of their consequences, precautionary and emergency measures to apply in each case are considered. Connections are finally made between these problems in nuclear plants and similar problems encountered in nonnuclear plants. (INIS)

23606 CERTAIN PROBLEMS OF SAFETY OPERATION AT ATOMIC POWER STATIONS BASED ON FAST GAS-COOLED REACTORS USING A DISSOCIATING HEAT-TRANSFER AGENT. Sharovarov, G. A. At. Energ. (USSR); 34: No. 6, 435-440(Jun 1973). (In Russian).

Peculiarities of technological circuit and thermodynamic cycle in case of a dissociating heat-transfer agent allow preservation of continuity in circulation and organization of primary heat removal. It is expedient to use a special system in which a heat-transfer agent in the liquid phase can be used for emergency reactor shutdown cooling. It is necessary to provide for limitation of the flow rate of the heat-transfer agent from the region of high pressure in order to prevent deformation and destruction of the reactor parts. (auth)

23607 ASEISMIC DESIGN OF BWR POWER PLANT. Ichiki, T.; Fukasawa, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 28: No. 5: 503-507(May 1973). (In Japanese).

The basic criteria for aseismic design of nuclear power plants; experiments conducted in Toshiba on the aseismic property of reactor cores, other principal machines and piping; present status of theoretical analysis including the finite element method; and an outline of problematic points regarding aseismic design of power plants are discussed. The reliability of aseismic construction should be improved through these analyses. (auth)

23608 EXPERIMENTS FOR THE PRODUCTION AND INVESTIGATION OF AEROSOLS OF SODIUM AND SODIUM OXIDE. Boehm, L.; Jordan, S.; Schikarski, W. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From working meeting on aerosol techniques; Frankfurt am Main, Germany (18 Oct 1972).

The analysis of malfunctions in fast breeder reactors due to the escape of liquid sodium requires the solution of questions with regard to the combustion kinetics and aerosols occurring during sodium combustion. The results of measurements are as follows: within the range of concentration under investigation, the rates of formation of aerosols have been found to increase with a rise in oxygen concentration whereas the reaction or combustion time is decreased; the maximum amount of airborne aerosols is proportional to the oxygen content (some grammes per m^3 even at low oxygen concentrations); and a large share of airborne aerosols is very quickly deposited onto the container walls but an airborne concentration of 10 to 20 mg/m^3 will still remain for some hours. (GE)

23609 EXPERIMENTAL BASIS FOR BWR EMERGENCY CORE COOLING. Imhoff, D. H.; Murray, J. L. (General Electric Nuclear Energy Division, San Jose, CA). Energy Int.; 9: No. 12, 26-29(Dec 1972).

The current BWR emergency core cooling systems consist of the High Pressure Core Spray (HPCS), Low Pressure Core Spray

(LPCS), 3 Low Pressure Coolant Injection (LPCI) and the Automatic Relief System (ARS). The HPCS protects against small breaks and depressurizes the reactor so that the LPCS and LPCI water can enter. The ARS provides backup depressurization if the HPCS does not actuate. The LPCI delivers a large flood of water to quickly refill the vessel. The BWR is protected by three cooling systems and spraying and flooding. (FS)

23610 HYBRID STATIC-DYNAMIC HEATING TECHNIQUE FOR THE MEASUREMENT OF DOPPLER EFFECTS. Russell, G. J.; Madison, WI; Univ. of Wisconsin (1973). 188p. University Microfilms Order No. 73-10,736.

Thesis (Ph.D.).

The Doppler effect, which is due to an increased interaction between neutrons and absorber nuclei in a sample as the absorber-temperature is raised, has long been recognized as an important shutdown mechanism for both thermal and fast reactors. The Doppler effect has been traditionally measured by one of two techniques: (1) reactivity experiments and (2) activation experiments. Low temperature Doppler effects (<2000°K) have been thoroughly studied in both thermal and fast reactor spectra. In a transient overpower in a ceramic-fueled nuclear reactor, the Doppler effect occurs in the fuel which is initially at a temperature of about 1500°K or higher; consequently, the shutdown Doppler effect has to be induced by fuel temperatures in excess of 1500°K. The two standard methods of measuring Doppler effects in steady-state reactors have been limited in attainable temperature by: (a) power density in Doppler furnaces used to heat the samples and (b) excessive heat loss to the reactor environment. A method of increasing the temperature at which Doppler effects can be measured is to use the entire reactor core as a Doppler sample and initiate a reactor excursion. The activation analog to such a Pulsed Reactivity experiment is a Pulsed Activation Doppler (PAD) experiment. In a PAD experiment, a Doppler sample enriched with a fissible isotope is encapsulated, placed in a reactor, and the reactor pulsed. Fission energy deposited adiabatically in the sample during the pulsed-irradiation is used to heat the sample. Neutron absorptions in the Doppler sample occur concurrently with pulsed-fission-heating. In the present work, the PAD method was enhanced and the versatility greatly increased by the development of a static-dynamic heating technique for conducting a PAD experiment. (Diss. Abstr. Int., B)

Reactor Theory and Calculation

Refer also to abstracts 22735, 22736, 23015, 23466, 23487, 23492, 23577, and 23717.

23611 (AAEC/LIB/Bib-383) STATISTICAL ANALYSIS FOR DETERMINING THE INFLUENCE OF HOT CHANNEL FACTORS AND FOR ASSESSING THERMAL HYDRAULIC REACTOR PERFORMANCE. A Bibliography, 1962–1972. Geue, P. J. (Comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

Seventy-eight references are given chronologically by year, covering 1962–1972. Each year is arranged alphabetically by author. Reference is made to abstracts for citations in NSA and INIS. (auth)

23612 (AEEW-M-1163) SPECIAL TREATMENT OF AN ANNULAR GAS GAP IN DIFFUSION THEORY CALCULATIONS OF MONOPOLE AND DIPOLE FLUXES IN A WIGNER–SEITZ CELL. Allen, F. R. (Atomic Energy Establishment, Winfrith (England)). Jun 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

QUAVER one-dimensional diffusion theory flux calculations in certain pressure tube lattice cells require special diffusion coefficients for the large radial gas gaps. The Newmarch Theory used in the monopole flux calculation has been extended to define new diffusion coefficients for the dipole (tilted flux) calculation. This is important for the evaluation of cell diffusion coefficients and dipole parameters for heterogeneous reactor calculations, which influence the prediction of cross-cluster power tilts. (auth)

23613 (BNWL-1756) MTR-PHOENIX FUEL EXPERIMENT: BURNUP ANALYSES AND CORRELATIONS. Smith, R. I. (ed.) (Battelle Pacific Northwest Lab., Richland, Wash). Jun 1973. Contract AT(45-1)-1830. 69p. Dep. NTIS $5.45.

A burnup experiment was performed in the MTR at NRTS which utilized a full core loading of Phoenix fuel (Al-21 wt % Pu with 23 at. % ^{240}Pu). Results from this experiment included the variation of isotopic composition with burnup and with position throughout the core and the measured rates of reactivity loss with burnup. The measured results are compared with the results of calculations made for Phoenix fuel core in MTR. Conclusions are drawn concerning the adequacy of the computational methods and calculational models used in the comparisons. (auth)

23614 (DP-MS-72-46) APPLICATION OF SPACE–TIME DIFFUSION THEORY TO SUBCRITICAL PULSED NEUTRON EXPERIMENTS. Parks, P. B.; Ahlfeld, C. E.; Spencer, J. D.; Stewart, J. W. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 23p. (CONF-721109-27). Dep. NTIS $3.25.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

Comparison of the subcritical reactivity determined with the space-time method of analysis and the area analysis methods suggests that the former method is a reliable model of pulsed neutron experiments in shutdown thermal reactors. The two dimensional space-time code DISCOTHEQUE was used as the calculational model in these comparisons. The space-time method is shown to be free from the distorting effects of delayed neutron harmonics 14 references. (auth)

23615 (DP-MS-72-47) SPACE–TIME KINETICS EXPERIMENTS EMPHASIZING DELAYED NEUTRON HOLDBACK. Parks, P. B.; Currie, R. L.; Baumann, N. P.; Stewart, J. W. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. 30p. (CONF-721109-28). Dep. NTIS $3.50.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

A series of experiments is under way at the Savannah River Laboratory to provide benchmark data against which space-time codes can be tested. These measurements are being performed in the heavy water-moderated Process Development Pile (PDP). These experiments are restricted to delayed critical or to subcritical transients. Therefore, the delayed neutron holdback is the only neutronic space-time phenomenon accessible in these experiments. The experimental procedures and results are presented. 7 references. (auth)

23616 (DP-MS-72-49) COMPARISON OF THE QUASISTATIC AND DIRECT METHODS FOR TWO-DIMENSIONAL THERMAL REACTOR DYNAMICS. Dodds, H. L. Jr.; Stewart, J. W. II.; Bailey, C. E. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 25 Aug 1972. Contract AT(07-2)-1. 19p. (CONF-721109-26). Dep. NTIS $3.00.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

The quasistatic method of performing multidimensional reactor transient calculations is presented. The accuracy and computing efficiency of the method for two-dimensional transients with feedback are discussed. The basis of comparison is the TWODTA code which uses a direct finite-difference method of solution. (auth)

23617 (DP-MS-72-62) INTERFACE CURRENT TECHNIQUE FOR TWO-DIMENSIONAL CELL CALCULATIONS. Anderson, M. M.; Honeck, H. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 17p. (CONF-730414-4). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

A formulation of the interface currents technique which permits the inclusion of anisotropic scattering and is applicable to reactor cells containing arbitrarily shaped two-dimensional regions is presented. The interface currents technique, which until recently has been limited to the cosine currents formulation, couples cell regions to their nearest neighboring regions by assumed angular flux and current distributions at the region interfaces. The formulation presented uses a multi-component angular expansion of the interface currents and regionwise multiple collision sources, and defines neutron transmission and escape matrices by using a systematic method of transferring neutrons between the components of the angular expansions. An expansion of the half-space angular fluxes at each region interface in a P_1 series about an arbitrary direction relative to the interface normal is discussed. A two-dimensional fixed-source calculation is used to compare this angular expansion to a P_0 and P_1 expansion of the interface fluxes about the interface normal. 4 references. (auth)

23618 (DP-MS-72-63) CORRELATION OF LATTICE PHYSICS PARAMETERS FOR REACTOR CALCULATIONS. Buckner, M. R.; Honeck, H. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 18p. (CONF-730414-5). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

Lattice physics parameters for many different lattice states are necessary for detailed static or dynamic reactor calculations.

Due to the voluminous amount of data required, a JOSHUA module called CRAB (Cross Section Reduction and Blocking) was developed to provide a compact representation of such data. CRAB provides the capability of correlating lattice parameters as functions of one or more lattice state parameters by least-squares fitting the few-group data using orthonormal polynomials. This method successfully provided macroscopic cross sections as a function of seven lattice parameters for two-group, two-dimensional reactor transient calculations. 3 references. (auth)

23619 (DP-MS-73-17) RECENT DEVELOPMENT OF METHODS FOR MULTIDIMENSIONAL REACTOR DYNAMICS. Stewart, J. W. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab). 1973. Contract AT(07-2)-1. 15p. (CONF-730414-9). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

The need for multidimensional dynamics analysis is discussed. The mathematical and computational difficulties associated with the solution of the few-group transient neutron diffusion equations are discussed. Solution methods applicable to multidimensional reactor geometries are reviewed with particular emphasis on direct iterative methods, splitting methods, and the quasistatic method. The particular need for coupled neutronic, hydraulic, thermal, and mechanical analysis codes is discussed. (38 references) (auth)

23620 (DP-MS-73-19) CURRENT TRENDS IN THE DEVELOPMENT OF COMPUTER SYSTEMS FOR REACTOR ANALYSIS. Honeck, H. C. (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 11p. (CONF-730414-6). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

The past years have seen the development and maturation of modular data-based systems. These systems have, for the most part, satisfied the objectives of operational convenience, efficiency, and economical growth. The future development of these systems will emphasize the effective use of the stored data and will evolve into reactor information systems. (auth)

23621 (EIR-237) DIFFUS: A PROGRAM BASED ON THE SCATTERING THEORY FOR THE TWO-DIMENSIONAL CALCULATION OF NEUTRON FLUXES. Paratte, J. M. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenligen (Switzerland)). May 1973. 172p. (In French). Dep. NTIS (U. S. Sales Only) $10.75.

A scattering code was constructed with the following characteristics: rapidity; controlled regions which are arbitrary regions in the lattice which can be represented by conditions at the limits $\beta = J/\Phi$; in addition to the usual interaction on k_{eff}, provisions are made for iterations on buckling, poison density, and the leak current; the results can be used for the calculation of the distribution of the power, mean of the group constants on the lattice, and calculation of k_∞ and M^2 on the lattice. Other characteristics are imposed by the group constants, the internal mixing, and the fictive constants. The development of this program is described in detail. 10 references. (JSR)

23622 (FRNC-TH-377) COMPARISON BETWEEN THE RESULTS OF NUCLEAR REACTOR CELL CALCULATIONS MADE USING THE APOLLO CODE AND EXPERIMENTAL RESULTS OBTAINED WITH DIFFERENT TYPES OF REACTORS. Mikhail, M. L. (Paris Univ., Orsay (France)). 1972. 82p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis.

A critical study of the Apollo code is presented. The measured values were compared to the calculated values for the material buckling (especially for light water lattices) and the age of the three principal moderators. The light water lattices selected are those of in-pile experiments involving a single zone (more accurate measurements of the buckling) constituting a square or rectangular lattice with cylindrically shaped fuel elements with varying degrees of enrichment. In order to verify the validity of the Apollo code, the reactivity corresponding to the experimental value of the buckling (a quantity which should be zero within the limits of experimental error) is calculated for each lattice. The reactivities obtained using Apollo were not zero. The Apollo results were thus corrected in order to eliminate these errors and an attempt made to obtain a zero reactivity. The heavy water lattices selected are those of experiments in the Aquilon pile concerning natural uranium metallic rods. In the case of graphite reactors, it was preferred to assume the Coregraf is sufficiently well fitted to allow a direct comparison to be made between Apollo and the code. A simple fitting is proposed which uses as a starting point measurements of the buckling of light water lattices. Apart from the correction for epithermal neutron losses, no attempt was made to modify either the ^{238}U fission cross sections in the thermal energy range. The fitting nevertheless remains satisfactory for both of the other moderators. (FR)

23623 (IAE-2157) PROGRAM FOR CALCULATING THE DISTRIBUTION OF NEUTRONS, XENON, AND IODINE IN A SLAB REACTOR. Semenov, V. N. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 12p. (In Russian). INIS.

The FIKS program was designed to compute xenon processes in the core of a slab reactor. A quasi-steady state approximation was employed to calculate the neutron field. It is proposed that reverse coupling with respect to power acts on the reactivity instantaneously, and that a homogeneous control system instantly succeeds in compensating for a change in reactivity, and maintains constant the total number of neutrons in the reactor core. The influence of delayed neutrons and the time and spatial distribution of neutrons was neglected. A steady state equation for the neutron flux in a single-group approximation was written in an integral form with the aid of a generalized Green function. A change in the neutron flux in time was caused by the dependence of the local breeding coefficient on the Xe concentration. The multiplication coefficient of the lattice may be changed according to the core volume, and is a function of the power and Xe poisoning. The migration area of neutrons is assumed to be independent of the coordinates, power, and poisoning. Differential equations of the reverse coupling which describe the time-change of Xe and I concentrations, were solved by the Runge-Kutta method jointly with the solution of the equation for the neutron flux by the method of successive approximations. The FIKS program was written in code for the 220 computer and uses only the operative memory. Computation of one step of the transitional process required on the average ≤10 sec of machine time. (tr-auth)

23624 (IFA-FR-97-1973) EROS, ZERO-DIMENSIONAL CODE FOR CALCULATING VARIETIES RELATIVE TO A BILINEAR FUNCTION. Boeriu, S.; Cepraga, D.; Cristian, I.; Cuculeanu, V.; Turcanu, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 9p. (In Rumanian). Dep. NTIS (U. S. Sales Only) $3.00.

The Boltzmann linear function for neutron fluxes and its applications are discussed along with flux calculations. The input and output for the EROS code, designed to evaluate the functions used in reactor physics for calculating perturbations, are mentioned briefly. (TTT)

23625 (IFA-FR-107-1973) CAIN: A ONE DIMENSIONAL MULTIGROUP DIFFUSION EQUATION CODE. Boeriu, S.; Cepraga, D.; Ciupitu, E.; Cristian, I.; Cuculeanu, V. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The CAIN-code is a one-dimensional (plane, cylinder, sphere) diffusion theory code for use in fast reactor analysis. The code searches on critical dimensions and its main output is: real and (or) adjoint fluxes; multiplication factor; integrated fluxes per region per group; and fission source distribution. 6 references. (auth)

23626 (IFA-FR-108-1973) DEVELOPMENT OF A FORWARD KOLMOGOROV FORM EQUATION WITH A PROBABILITY-BALANCE FOR A TIME-, SPACE- AND ENERGY-DEPENDENCE REACTOR, WITH LOCALIZING DETECTORS. Cristea, G. Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

23627 (JPRS-59775) APPLICATION OF A MODEL OF A POROUS BODY FOR CALCULATION OF THE FIELD OF VELOCITIES AND TEMPERATURES IN A REACTOR CORE. Kolmakov, A. P.; Yur'ev, Yu. S. 1971. Translation of FEI-249. 11p. NTIS.

A discussion of a system of differential equations of hydraulics and heat transfer for a reactor core as a "porous body" with anisotropic properties is presented. A solution in a linear approximation for a case of small deviations of the geometry of the channels is included. 6 references. (auth)

23628 (KFK-1765) EIGENVALUE THEOREMS FOR THE DISCRETE FORM OF THE MULTIGROUP DIFFUSION- AND TRANSPORT EQUATIONS. Kinnebrock, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

The existence of a positive eigenvalue is proved for the discrete form of the multigroup diffusion equations and for the discrete multigroup Boltzmann equations; the convergence of outer iterations may be concluded. The following assumptions are made: a neutron introduced at any point in the reactor may diffuse to all locations of the assembly (i.e., the diffusion regions for all energy groups are the same), only downscattering is permitted,

and the fission transfer matrix is multiplicative. Then a necessary and sufficient condition is derived for the existence of a greatest single eigenvalue (k-effective) and the corresponding non-negative eigenvector (neutron flux). (GE)

23629 (LFEN-NI.-77-b) CONSISTENCY SEARCH FOR DIFFUSION THEORY CODES. Jorge, H. M. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

As a cross-check of diffusion theory code consistency, the same problem was run with two one-dimensional codes, FAIMOS and MAIDS-2, and one two-dimensional code, PHENIX. The problem analyzed was the criticality for an infinite cylindrical reactor composed of one axial region and two radial regions (fuel and reflector). (auth)

23630 (MRR-88) PIMFUX: A THREE-DIMENSIONAL MODEL FOR THE SIMULATION OF REACTIVITY DISTURBANCES BY MEANS OF THE TWO-GROUP DIFFUSION THEORY. Schmidt, A. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Aug 1971. 16p. (In German). INIS.

PIMFUX is a three-dimensional, two group, space-time diffusion theory program for rectangular geometries. An arbitrary number of groups of delayed neutron precursors may be used. Temperature feedback effects are accounted for via adiabatic heating of fuel. The relevant differential equations are represented by space-time difference equations which are solved at each time step by an explicit finite difference procedure using two time levels. The governing equations, solution technique in general and specific behavior of the program are discussed. (INIS)

23631 (MRR-107) POSSIBILITIES OF A HYBRID CALCULATOR IN THE SIMULATION OF SPACE-TIME-DEPENDENT NEUTRON KINETICS. Langenbuch, S. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Aug 1972. 54p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

For a hybrid simulation of neutron dynamics in a reactor core the literature dealing with methods for solving partial differential equations of parabolic type is first reviewed. The stationary and dynamic solution to the diffusion equation with two energy groups and six groups of delayed neutrons is discussed. The iterative method used discretizes the space variables and integrates continuously in time. The results and the running time of the hybrid program are compared with those of a digital program. (GE)

23632 (ORNL-TM-4101) STATISTICAL ERRORS IN SUBCRITICAL REACTIVITY INFERRED FROM INVERSE KINETICS ROD-DROP MEASUREMENTS USING THE THREE-POINT METHOD. Allen, J. W.; Robinson, J. C.; Ackermann, N. J. Jr. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 40p. Dep. NTIS $4.00.

A study was made to determine the uncertainty in subcritical reactivity as inferred from inverse kinetics rod-drop experiments (using the three-point method) due to the statistical uncertainty inherent in the observed count rate of the neutron sensor. The two methods employed were: a classical propagation of error analysis, and an analysis of simulated repeated rod-drops, with an assumption that the uncertainty in reactivity was due to the detection process itself for both techniques. To test the analysis methods, the reactivity uncertainties for various experimental rod-drop data sets were computed by both methods. There was excellent agreement of the results. The propagation of error analysis may be used on three-point subcriticality measurements to provide an experimenter with an index to the statistical reliability of the inferred reactivity estimate. 3 references. (auth)

23633 (RT/FI-(73)13) CNEN REVISED VERSION OF THE RIGEL ETOE-MC^2 CODE SYSTEM TO GENERATE MULTIGROUP CROSS SECTIONS AND ITS USE WITH ENDF/B-III DATA. (Gheorghe, D.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 6 Apr 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

A revised version of the RIGEL-ETOE-MC^2 code system was developed for use with CNEN computing facilities. Codes modifications, use with ENDF/B-III data, and experience gained with general interest test problems, are described. (auth)

23634 NEUTRON RESONANCE ABSORPTION IN HETEROGENEOUS FAST REACTOR ASSEMBLIES. Ishiguro, Yukio (Argonne National Lab., IL). Nucl. Sci. Eng.; 51: No. 4, 441-455 (Aug 1973).

A practical method is derived for calculating the effective resonance cross sections in fast reactor assemblies with complicated geometry. The conventional equivalence relation between homogeneous and heterogeneous resonance integrals is extended to the complicated geometries which are composed of various types of plates, including two types of fuel plates with different compositions. This extended equivalence relation indicates that the effective cross sections in a heterogeneous system can be calculated by using a cross-section set of the Bondarenko type. The numerical results for the effective cross sections given by the present method are in good agreement with the exact values obtained by the RABID code. (auth)

23635 EXACT ANALYTICAL SOLUTION OF AN ELEMENTARY CRITICAL CONDITION. Siewert, C. E. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 51: No. 1, 78(May 1973).

A real solution of the critical condition for an unreflected nuclear reactor, described by age-diffusion theory, is reported. (auth)

23636 EVALUATION OF LUMPED PARAMETER HEAT TRANSFER TECHNIQUES FOR NUCLEAR REACTOR APPLICATIONS. France, D. M.; Ginsberg, T. (Argonne National Lab., IL). Nucl. Sci. Eng.; 51: No. 1, 41-51(May 1973).

An analytical study was performed to investigate the utility and accuracy of the lumped parameter approach to heat transfer analysis in a nuclear reactor subassembly. It is shown that the lumped parameter approach is a useful mathematical method if the appropriate heat transfer length scales associated with diffusion heat transfer are employed. Important results supporting the utility of the lumped parameter approach indicate that in the parameter range of interest the length scales are geometry-dependent only. They are shown to be independent of radial power distribution across the subassembly, and asymptotic values which are equal to length scales corresponding to the thermally fully developed condition may be used in the thermally developing entry region which encompasses the entire axial length of typical nuclear reactor subassemblies. Two characteristic length scales are presented and may be easily applied in lumped parameter steady-state heat transfer calculations in spacer-free triangular arrays of nuclear fuel elements within the range of parameters of interest for nuclear reactor applications. These length scales apply to fuel rods adjacent and nonadjacent to subassembly walls, respectively. (auth)

23637 STABILITY OF SPACE-DEPENDENT SYSTEMS. de Veiga Watson, F. Los Angeles; Univ. of California (1972). 63p. University Microfilms Order No. 73-10,491.

A procedure to find the existence and domain of asymptotic stability for a class of non-linear system of partial differential equations is presented in the context of semigroup theory. No a priori bound is imposed on the non-linearity which is assumed to be a quadratic (bilinear) or multilinear form. The linearized system can be non-selfadjoint and need not be asymptotic stable equation by equation. The solution of the stability problem is carried out in two steps: the development of (a) an L_2 norm that bounds above the sup norm while keeping the negative equiboundedness property of the semigroup generated by the linearized system and (b) accurate estimates for the norm of this semigroup, both with respect to the norm previously developed and to the usual L_2 norm. To illustrate the computational method, a few examples taken from nuclear reactor models are presented and the main difficulties discussed. (Diss. Abstr. Int., B)

23638 INTERPRETATION OF THE CENTRAL CELL REACTIVITY WORTH AND EXPERIMENTAL DETERMINATION OF A CHARACTERISTIC VALUE OF THE REACTOR CELL COMPOSITION k_m^+. Nakano, M.; Iijima, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 2, 69-79(Feb 1973).

It has been shown that the reactivity worth of the central cell may be considered equal to the worth of the leakage neutrons from the cell. Thus, the value may be used to evaluate the results of neutron leakage calculations. A method is proposed for the experimental determination of k_m^+, a characteristic value of the reactor cell composition, by making use of the reactivity worth of the cell measured at the core center. The quantity k_m^+ is a kind of infinite multiplication factor defined in the fundamental mode spectra. Since accurate methods based on the fine group treatment are available for calculating k_m^+, its measurement is valuable for evaluating the cross section library used for reactor calculations. As an example, the value of k_m^+ has been obtained for the FCA Assembly V-2, and the resulting experimental and calculated values are examined. (auth)

23639 METROLOGICAL PROBLEMS OF NEUTRON MEASUREMENTS AT NUCLEAR REACTORS. Vasil'ev, R. D. At. Energ. (USSR); 34: No. 4, 277-282(Apr 1973). (In Russian).

A brief description is given of the main experimental and theoretical problems and the contemporary state of metrological problems of neutron measurements in nuclear reactors. Direct and indirect measurements of separate derivatives of physical quantities characterizing neutron fields and joint measurements of quan-

tities performed for the purpose of determining relationships are discussed. The reasons for possible divergence of measurement results obtained by various experimenters are discussed and a metrological approach to the elimination of divergences is given. (auth)

23640 STOCHASTIC PROCESS IN A NUCLEAR REACTOR WITH FUEL TEMPERATURE FEEDBACK. 2. Measurements of Some Reactor Parameters. Isnard, R. (Ecole Polytechnique, Lausanne, Switzerland). Rev. Phys. Appl.; 8: No. 1, 19-26(Mar 1973). (In French).

In order to experimentally verify the model previously established, a system was developed to measure fluctuations in the neutron population and the temperature of the fuel. The Fourier transform of the correlation curves provided by a 400 point correlator enabled the neutron and thermal power spectral densities to be determined. The cut-off frequency of the thermal and neutron power spectral densities was used to deduce the mean lifetime of the neutrons and the heat transfer coefficient between the fuel and coolant. (FR)

23641 STOCHASTIC PROCESS IN A NUCLEAR REACTOR WITH FUEL TEMPERATURE FEEDBACK. 1. Theoretical Development. Isnard, R. (Ecole Polytechnique, Lausanne, Switzerland). Rev. Phys. Appl.; 8: No. 1, 7-17(Mar 1973). (In French).

A stochastic analysis of reactor kinetics enabled a description to be developed for the random fluctuations of certain physical variables about their mean values. These fluctuations can be characterized by their spectral density. The neutron populations, the precursor nuclei populations, and the fuel temperature are considered to be random variables. The stochastic process occurring in a nuclear reactor is described by a space and energy independent random Markovian process using the Chapman–Kolmogoroff equations. The Fokker–Planck and Langevin approximations enable the spectral densities to be calculated for the fluctuations in the number of neutrons, the fuel temperature, and the neutron fuel temperature interaction. These spectral densities are analyzed in order to determine the range in which certain parameters such as the reactor power, the thermal exchange coefficient, and the fuel temperature coefficient have an effect. The mean lifetime of the neutrons and the heat transfer coefficient can be estimated from the spectral densities. (FR)

23642 NEW MEASURING DEVICE FOR THE ROSSI-α-EXPERIMENT. Hoffmann, K. (Technische Univ., Darmstadt, Ger.). Atomkernenergie; 21: No. 2, 99-104(1973). (In German).

A new experimental arrangement for measuring distances of counter pulses is described. The measured values of these distances (microseconds up to minutes) cover a range of 9 decades. They are transferred in a computer-compatible format to a digital magnetic tape without any processing. In order to save space and recording time they are represented by data words of variable length. Then they are processed by a computer, simulating the experiments by means of the stored data. (In contrast to this procedure, data processing is usually done during the experiment, mostly by some kind of sorting.) This procedure allows simulation not only of known experiments with a wide range of parameters, but also new ones which cannot be carried out by processing the pulses during the experiment. Also, it is much easier to compare different methods since the same data can be used to simulate all types of experiments. As an example, the results obtained by simulating the Rossi-α-experiment with and without additional conditions are reported. Therefore it can be concluded that the present approach of counting a neutron after having started a measuring cycle by a preceding one does not comply with reality. (GE)

23643 NEUTRON WAVE PROPAGATION IN FINITE ASSEMBLIES OF GRAPHITE. Kumar, A.; Ahmed, F.; Kothari, L. S. (Univ. of Delhi). J. Nucl. Energy; 27: No. 7, 485-509(Jul 1973).

Neutron-wave propagation in graphite assemblies of finite transverse dimensions was studied in the diffusion theory approximation using multigroup (30 groups) approach and energy dependent boundary conditions. Frequency dependence of the thirty eigenvalues is discussed. It is shown that the critical frequency f^* depends upon transverse size. For infinite transverse size f^* is nearly equal to 130 Hz whereas for some critical transverse dimensions (in the present case lying between 80×80 cm^2 and 70×70 cm^2) f^* becomes zero. The existence of a pseudo-discrete mode in the continuum is discussed. Strong interference between the cold neutron density is predicted at some specific distance from the source. The position and intensity of interference is found to depend upon the frequency of the wave, the transverse size of the assembly, the energy spectrum of the source neutrons, and the temperature of the moderator. Neutron wave propagation in finite assemblies of graphite at 200°K and 150°K is also discussed. (auth)

23644 REMARKS ON A FEW PROBLEMS IN THE THEORY OF POWER REACTOR NOISE. Kosaly, G. (Central Research Inst. for Physics, Budapest). J. Inst. Nucl. Eng.; 14: No. 3, 67-73 (May 1973).

Noise problems in zero-power reactors are quite well understood, noise analysis of power reactors is still in its infancy, due mainly to a lack of basic knowledge of the many noise mechanisms involved. The problem is complex, because whereas in a zero-power reactor a single noise source, the stochastic nature of the fission branching process, is responsible for correlated neutron fluctuations, in a power reactor a great variety of possible sources exists, for example, stochastic generation of steam bubbles in the coolant, mechanical vibration of fuel elements due to turbulent velocity fluctuations, etc., all of which can give rise to noise. In a zero-reactor it is mainly the neutron flux, and in some cases also the γ-flux, which is accessible to noise analysis, in a power reactor there are also several other fluctuating parameters that must be analyzed in a comprehensive study, for example, coolant and fuel temperatures, coolant velocity, displacements of fuel and control elements, etc. The following aspects are discussed: noise induced by boiling of the coolant; noise induced by gas bubbles entrained in liquid coolant; neutron noise induced by mechanical vibration of fuel and/or control elements; the transfer function relating inlet temperature fluctuations to neutron noise; and the transfer function relating coolant velocity fluctuations to neutron noise. (UK)

23645 ANALYTICAL STUDY OF OPERATING REACTOR NOISE ON A SINGLE CHANNEL AND A SINGLE PHASE FLOW MODEL. 1. Propagation of Noise Sources. Saito, K. (Hokkaido Univ., Sapporo). J. Nucl. Sci. Technol. (Tokyo); 10: No. 5, 259-267(May 1973).

Basic formulas to describe the propagation of a periodically modulated driving source are derived on the distributed model of atomic power reactors. Disturbances in the neutron field are regarded as being promptly spread over the whole core in the frequency domain of usual interest for noise and frequency response analyses. On the basis of this approximation, a coupled set of kinetic equations for neutrons, fuel and coolant temperature are derived and solved for the case where a driving source of unit strength is imparted. The relations between the solutions obtained and the formulas for analyzing experiments are established. Comparisons are made qualitatively between the results and those of the lumped model. The existence of a sink and of resonance frequency is examined. The power spectral density of neutron fluctuations in a water reactor under forced circulated cooling shows a sharply varying configuration when the inlet coolant temperature fluctuations are the major noise sources. When the reactor is under natural convective cooling or under liquid metal cooling, no such characteristic features appear. (auth)

23646 NEW METHOD FOR MEASURING THE REACTIVITY OF A NUCLEAR REACTOR. Shishin, B. P. At. Energ. (USSR); 33: No. 4, 839(Oct 1972). (In Russian).

This paper was summarized as paper No. 610/6542 with full copy held by TIC.

The extension of the "double overcompensation" method to generalized reactivity for determining reactivity on the basis of measured decay constants of prompt neutrons of subcritical and critical reactors, when the breeding properties are varied, is explained. Neutron balance equations are written in operator form, as well as the corresponding adjoint equations, based on the ω-model of the reactor where the eigenvalue of the problem is the ω-reciprocal prompt neutron period. (FS)

23647 SYNTHESIS METHOD OF INTEGRAL TYPE. Takeda, T.; Azekura, K.; Sekiya, T. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 4, 207-213(Apr 1973).

The synthesis method is combined with the first-flight collision probability method to treat the nonuniformity of the medium along the axial direction. The neutron flux in a three-dimensional system is expressed by the product of a known trial function in the horizontal plane and an unknown function along the z-axis. The trial function in the x-y plane is evaluated in terms of the first-flight collision probability calculated in either one or two-dimensional system. The unknowns are determined in each axial subzone by solving simultaneous equations with use made of the first-flight collision probability in a system reduced to one dimension by adopting a homogenized cross section. As an example the flux distribution in the axial direction in a finite lattice cell composed of a moderator and a fuel rod with two different compositions in the upper and lower axial zones is calculated. (auth)

23648 NEW DIFFERENCE EQUATION FOR DIFFUSION CALCULATION. Aoki, K.; Tsuiki, M. (Nippon Atomic Industry

Group Co. Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 5, 274-283(May 1973).

A new difference equation for the numerical solution of the one-dimensional diffusion equation was obtained by using a semi-analytic method, in which the only approximation employed is that the source distribution within a mesh-region is represented by a linear function. A test program, EXX-1, was prepared and run for BWR calculations, and comparisons were made with the conventional method. The results show that by using the new difference equation, a very coarse mesh model (1 mesh point per material region) can be applied without seriously impairing the computational accuracy. It is also shown that the conventional difference equation becomes identical to the new expression if group-constants are multiplied by correction factors and the treatment of the source term appropriately modified. New difference equations for spherical and cylindrical geometries are also given in an appendix. (auth)

23649 APPLICATION OF INTERMEDIATE TREATMENT OF RESONANCE ABSORPTION TO HETEROGENEOUS FAST REACTOR ASSEMBLY. Ishiguro, Y. (Argonne National Lab., IL). Nucl. Sci. Eng.; 51: No. 4, 512-514(Aug 1973).

The intermediate resonance approximation of resonance absorption is applied to a heterogeneous fast reactor assembly to see how each resonance of ^{238}U deviates from the narrow resonance approximation. The resonance integral is calculated for the 50 resonances of ^{238}U in ENDF/B-II below 1.9 keV. The averaged deviation of these resonances from the narrow resonance extreme was found to be ~4%. It is concluded that the effective group cross sections in heterogeneous fast systems can be estimated reasonably well by the narrow resonance approximation, even though this approximation tends to underestimate the resonance integrals noticeably for a handful of resonances with extremely large neutron widths. (auth)

23650 ANALYTICAL STUDY OF OPERATING REACTOR NOISE ON A SINGLE CHANNEL AND A SINGLE PHASE FLOW MODEL. 2. Noise Sources. Saito, K. (Hokkaido Univ., Sapporo). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 348-352(Jun 1973).

Nuclear noise sources can be regarded as white both in frequency and space. The thermal noise source due to the fact that heat energy is transferred with a definite magnitude at the transfer surface is also white. On the other hand, noise sources that are associated with fluctuations in the relaxation time constants of temperature are usually not white whether in frequency or in space. Their properties can be completely determined from the measured power spectral densities (PSD) of the fluctuations in coolant velocity and density, as well as from their cross PSD. The hydrodynamical noise is due to the random variations in the heat removal rate of the coolant and turns out to be non-white. The mechanical noise source is determined from the PSD of the statistical reactivity modulations caused by fluctuations in the fuel and control-rod positions. (auth)

Reactor Components and Accessories

Refer also to abstracts 20981, 21295, 21433, 21886, and 22005.

23651 (BMFT-FBK-73-11) DECONTAMINATION OF REACTOR COMPONENTS. Subproject 2. Study on the Possibilities of Automizing the Determination of Fission and Corrosion Products in the Cooling Circuits of Nuclear Reactors. Neeb, K. H. (Siemens A. G., Erlangen (West Germany)). May 1973. 67p. (In German). Dep. NTIS (U. S. Sales Only) $5.50

Experiments and results of in-line γ-spectrometry using Ge(Li) detectors are described. By this technique the activity concentrations of the most important fission and activation products in primary coolants of water-cooled power reactors can be determined without taking a sample from the system. An in line-separation technique for radionuclides can give a marked increase in the range of application of in line-measuring technique. A computer program is used for the calculation of the γ-spectra obtained, starting with peak search and ending with the print of the activity concentrations. The computer program is applicable for very complexed γ-spectra of different types. (auth)

23652 (INIS-mf-660/7, pp vp Paper 7) DEVELOPMENT AND IMPROVEMENT OF THE PERFORMANCE OF THE EQUIPMENT FOR THE OPERATION OF SODIUM IN FRANCE. Raczynski, W. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Bois-Colombes, France); Le Frere, J. P.; Refoubelet, P.; Cazes, M. 1972. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The equipment which is necessary for the operation of the sodium installations has reached an industrial point and has stood the test of experience. The common characteristic is to be able to work continuously in a sodium temperature of 600°C, this value being the present temperature level for the installations built for the development of fast reactors cooled with sodium. Two kinds of equipment are examined: the electromagnetic pumps, and the measuring equipment. (INIS)

23653 NONDESTRUCTIVE TESTING VERIFIES RELIABILITY OF NUCLEAR REACTORS. Catlin, F. S. (Magnaflux Corp., Chicago). Metal Progr.; 104: No. 3, 55-56;58.

When reactors are constructed, contractors employ magnetic particle tests, fluorescent penetrant inspection, ultrasonic examinations, and radiography to make sure that all components meet stringent AEC specifications. Valves are also hydrostatically tested, as is the final assembly. (auth)

23654 REACTOR VESSEL. Koerner, R. J. (to United States Atomic Energy Commission). U. S. Patent 3,733,760. 22 May 1973. Filed date 5 Mar 1970. 10p.

A concrete pressure containment vessel for a nuclear reactor is described wherein an access opening therein is sealed by a closure member. A plurality of tendons extend generally parallel with the axis of the access opening and are distributed about the access opening and pass entirely through the main portion of the pressure vessel and also through the closure member. The tendons are placed under tension to secure and seal the closure member in place and to prestress the remainder of the pressure vessel. (Official Gazette)

23655 LOADING AND UNLOADING DEVICE FOR AN IRRADIATION CAPSULE OF A NUCLEAR REACTOR. Aust, W. (to Gutehoffnungshuette Sterkrade AG). German Patent 1,589,835. 19 May 1971. Filed date 20 Jun 1967. (In German).

A device is described which is composed of an irradiation capsule with pockets for receiving samples and of a pneumatic system with a sample transfer tube characterized by the fact that between the carousel and the transport tube there is a free space of a maximum of 1 mm. A shock absorber is found in each pocket of the capsule and a braking device is inserted in the transport tube above the reactor platform. (TSS)

23656 CONTROLLED LOSS CIRCULATION PUMP FOR NUCLEAR REACTORS. Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 96-102(May 1973). (In Italian).

The design, material selection, and fabrication of a controlled loss circulation pump are described. Control and inspection tests for the pump are outlined. (JSR)

23657 LEAKAGE TEST FOR THE CONTAINMENT SYSTEM OF NUCLEAR INSTALLATIONS. Mirandola, R. (Univ., Pisa, Italy). Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 89-96(May 1973). (In Italian).

Two methods for measuring the loss rate in leakage tests of containment systems are described: the absolute method and the reference chamber method. The intrinsic errors in the two methods are considered. The extrapolation factors necessary are discussed. As examples graphs are given of the rate loss calculated at 3 atm. (JSR)

23658 NUCLEAR REACTOR. (to Siempelkamp Giesserei KG). German Patent 1,941,229. 25 Feb 1971. Filed date 13 Aug 1969. (In German).

A nuclear reactor with a metallic-pressure vessel for holding the core is described. The pressure vessel is pre-stressed cast-iron and is stressed conjointly with the other cast iron elements such as the bottom plate and cylindrical segments or rings. The vessel is characterized by the fact that for the bottom plate and/or the top, in case of need, additional cylindrical segments or rings composed of blocks similar to building stones may be used. (TSS)

23659 TESTING REACTOR PROTECTION SYSTEMS ACCORDING TO THE ATOMIC LAW LICENSING PROCEDURE. Reik, M. (Technischer Ueberwachungs-Verein Bayern eV, Munich); Becker, W.; Sommer, P.; Wegener, H. H. (1972). vp. (In German).

The testing of reactor protection systems by the TUEV (Technischen Ueberwachungsvereine) according to the atomic law licensing procedure can be subdivided into specific task test sections. The purpose of these tasks is to submit expert advice and carry out the appropriate controls. The latter can be then subdivided into pretesting, construction supervision and licensing and function testing. A further periodical inspection is made. The aim of the five test sections is briefly explained. The official advisers point out the many uncertainties which occur with the

"extention" of a reactor protection system. A series of difficulties within the practice of testing reactor protection systems arise through a lack of coordination and information of the members taking part in the testing process. An improvement which is relatively simple to carry out is finally discussed. (GE)

23660 SAFETY OF NUCLEAR PRESSURE VESSELS AND ITS REGULATORY ASPECTS IN FRANCE. de Torquat, G. (Ministere du Developpement Industriel et Scientifique, Paris); Queniard, D.; Barrachin, B.; Roche, R. (1973). vp. (In French).

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

A survey is given on general pressure vessel regulations, regulations and standards for prestressed concrete pressure vessels (gas cooled reactors), and on developments of regulations for steel pressure vessels (light water reactors). (GE)

23661 MODELIROVANIA NAPRYAZHENII V KONSTRUKTSIYAKH YADERNYKH REAKTOROV. (Model of Stresses in the Construction of Nuclear Reactors). Taratorin, B. I. Moscow; Atomizdat (1973). 232p.

The theory and practical application of model simulation of nuclear reactor stresses are generally based on polarization-optical methods. Polymeric materials, and their optical, mechanical, and their thermal properties are examined as materials for model construction. Model design and construction are elucidated. Stresses in reactor vessels under non-axially symmetric deformation, effect of internal pressures, local stresses in certain elements of construction and in the vicinity of openings, and thermal regimes in reactor operation are subjects of special consideration. 88 references. (KSW)

23662 PNEUMATIC TUBULAR CONDUIT FOR THE IRRADIATION OF FUEL ELEMENTS AND SAMPLES OF MATERIALS. Dieck, E. L. (to Kernforschungsanlage Juelich GmbH). German Patent 1,756,374. 9 Apr 1970. Filed date 14 May 1968. (In German).

Pneumatic tubular conduits for the irradiation of fuel elements and samples of materials are described. The conduits have pipes connected between them and a device for deflecting the current of gaseous fuel. The two pipes for transport are connected by valves acting alternately and are provided with slide valves or cylinders as a device for stopping with the inlet tubes connected to the reservoir. (TSS)

23663 SURFACE PROTECTION IN NUCLEAR POWER PLANTS. Schliesing, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Cologne); Herms, R. Werkst. Korros.; 24: No. 4, 507-513(1973). (In German).

The corrosion protection of nuclear power plant by coating is rather complex a task because a coating has to be applied to all the concrete and steel surfaces; such a coating must be decontaminable as well as resistant to certain chemicals. In order to achieve an adequate useful life, it is indispensable that the porosity of the coating be as low as possible while the resistance to wear and irradiation as well as the adhesive strength must be high. The coating material preferred at the present time are epoxy resins, because their absorption is very low so that they counteract the build-up of irradiating matter in the workshops. A further description is given of those factors which have to be taken into consideration at the planning stage. (GE)

23664 DEVICE FOR MEASURING THE DEPOSITION OF SOLIDS IN NUCLEAR REACTORS. Fitzpatrick, V. F. (to United States Atomic Energy Commission). Australian Patent 416,027. 9 Aug 1971. Priority date 6 Dec 1967, United States of America (USA).

An instrumented nuclear fuel for measuring the deposition of solids on the surface of fuel elements in a nuclear reactor is described. It contains a core of nuclear fuel which has a concentration of fissionable atoms (uranium-235, uranium-233, plutonium-239) several times that in the normal fuel elements in the reactor. Surrounding the core is a heavy cladding of material having a fairly high capture cross section for neutrons, sufficiently thick to reduce the flux within the core to a small fraction of that outside the cladding. This gives substantially constant heat generation over a long period of time. A thin jacket surrounds the cladding. A thermocouple between the jacket and the cladding measures the temperature at that point. Increases in the difference between that temperature and the temperature of the coolant surrounding the device indicate the amount of deposition on the surface of the jackets. (AEC)

23665 NUCLEAR REACTOR CONTAINMENT SYSTEM FOR METROPOLITAN SITES. Pitt, W. A.; Lemon, R. B. (to United States Atomic Energy Commission). Australian Patent 416,428. 20 Aug 1971. Priority date 29 Dec 1967, United States of America (USA).

A concrete structure having three compartments is used to contain a nuclear reactor and its primary coolant system. The first compartment, a dry well, is centrally located and completely encloses the pressure vessel. A second compartment, filled with a liquid, is at a hydrostatic level above the first compartment. The third compartment, also filled with a liquid, is at a hydrostatic level below the first compartment. A first conduit communicates the first compartment with the third compartment for slow leaks. A second conduit, sealed with a rupture disc, communicates the first compartment with the second compartment upon rupture of the primary coolant system. A third conduit, sealed with a rupture disc, communicates the pressure vessel with the second compartment upon a large overpressure transient within the pressure vessel. Both hydrostatic compartments are vented to a common gas volume formed by an outer containment structure or reactor building. (AEC)

23666 METHOD AND COMPOSITION FOR DECONTAMINATION OF STAINLESS STEEL SURFACES. Weed, R. O. (to United States Atomic Energy Commission). Australian Patent 416,407. 27 Aug 1971. Priority date 28 Apr 1966, United States of America (USA).

The decontamination of water cooled nuclear reactor cooling systems, particularly those composed primarily of stainless steel is described. Stainless steel acquires, on long exposure to hot water, a tenacious magnetite film which, in systems exposed to neutron irradiation, incorporates radioactive isotopes. This film is removed by a solution including oxalic acid and dibasic ammonium citrate, ferric sulfate or nitrate and diethyl thiourea. When used in a system which has been given a preliminary treatment with a hot aqueous alkaline potassium permanganate solution, the new composition dissolves the film from the stainless steel and also dissolves the less tenacious films from other metals without causing corrosion of the metals. The deposition of secondary films containing radioactive contaminants, which have been produced by prior decontaminating solutions containing oxalic acid is avoided. (AEC)

23667 DESIGN PRINCIPLES OF REACTOR PROTECTION SYSTEMS. Stute, H. (Technische Ueberwachungsvereine eV, Cologne). (1972). vp. (In German).

From 8th IRS specialist meeting: the reactor protection system as a main safety problem installation in nuclear power plants; Cologne, Germany (20 Nov 1972).

A framework of design bases is presented by way of generalizing the single failure criterion. It shows how the reactor safety system as a central safety device in nuclear power plants results from safety analysis. The failure spectrum to be controlled by this system is presented. Single events to be considered in the design which may result in a failure of the safety system itself, and fundamental measures for their control are discussed. The development of the term "reactor safety system" and its practical use, the resulting extent as well as importance and influence of the actuation and interlocking switch system design of the actuators, frequently being characterized as part of the safety devices, are interpreted in connection with the reliability of the overall system. A contribution on the role of the reliability technique for the design of safety systems as well as a review on pertinent technical regulations conclude the work. (GE)

23668 INFLUENCE OF NEW APPROACHES IN SAFETY ENGINEERING ON THE DESIGN AND REALIZATION OF PROTECTIVE SYSTEMS IN FUTURE NUCLEAR POWER PLANTS. Repke, W. (Kraftwerk Union AG, Erlangen, Ger.). (1972). vp. (In German).

From 8th IRS specialist meeting: the reactor protection system as a main safety problem installation in nuclear power plants; Cologne, Germany (20 Nov 1972).

There are two main aspects which will lead to new developments in the design of future reactor protection systems. The meaning of the term "reactor protection system" has been gradually extended and covers a wider range of protective measures than before. The taking into account of possible influences not inherent in the system itself calls for alterations of the present design of such a system. The consequences of these two new approaches are discussed in detail. (GE)

23669 CLOSING PLATE FOR A REACTOR PRESSURE TUBE. Roloff, W. (to Rheinstahl Huettenwerke AG). German Patent 1,614,365. 13 Aug 1970. Filed date 24 May 1967. (In German).

A closing plate cooled with water for a moderator reservoir with a pressure tube is characterized by the fact that the space between the cold chamber and the collector inside the wall of the reservoir and the external cold chamber is filled with concrete. The tubes enclosing the fuel elements are surrounded for cooling by a tube of cladding for shielding the zones of cooling water which are in ladder form in such a way that the part of the cladding tube

turned toward the interior of the reservoir is larger than that of the external part. (TSS)

23670 IMPROVEMENTS IN AND RELATING TO APPARATUS FOR SEPARATING POLYPHASE MEDIA. Deich, M. E.; Filippov, G. A.; Sobolev, S. P.; Povarov, O. A. (to Moskovskii Ordena Lenina Energeticheskii Institut). British Patent 1,310,593. 21 Mar 1973. Filed data 26 Mar 1970. 7p.

Reference is made to an apparatus, termed a "turbo-separator," for separation of polyphase media in the turbines of atomic power stations, the term polyphase medium meaning a medium containing two phases, such as wet steam or a mixture of a gas and solid particles. The apparatus described comprises a guide blade assembly, a rotor, and collecting chambers adjacent to the rotor periphery. Each rotor blade has a varying profile from root to tip, with a turbine profile at the root and a compressor profile at the tip, and the angle of entry at the tip should not exceed 90°. The chord of each rotor blade may increase from root to tip by a factor not exceeding two, and the distance between the rotor blades and the blades of the guide blade assembly is preferably not less than one fifth of the height of the guide blade assembly. (UK)

23671 APPARATUS IN COMBINATION WITH A NUCLEAR REACTOR FOR TESTING FOR FUEL ELEMENT SHEATHING FAILURES AND A METHOD USING THAT APPARATUS. Burton, E. J. (to United Kingdom Atomic Energy Authority). British Patent 1,306,071. 7 Feb 1973. Filed date 10 Apr 1969. 3p.

Reference is made to methods for testing for fuel element sheathing failures in liquid cooled nuclear reactors by detecting gas escape from the fuel elements into the coolant. In the system described a duct is provided defining a constrained flow path for liquid coolant, together with means for imparting (a) a vortex motion to coolant entering the duct and (b) means for imparting a straightening motion to coolant leaving the duct. An opening is provided in a further duct between (a) and (b) with means to detect the pressure of gas at the opening. Means (a) may comprise a central boss having vortex imparting vanes and means (b) a smaller diameter boss having straightening vanes. The opening in the duct should face in the downstream direction. The pressure detecting means may comprise a differential pressure transducer, connected as described. (UK)

23672 FULL PENETRATION WELDING FOR THE MANUFACTURE OF FLANGES, SKIRTINGS, THICK FLOORS IN THE FORM OF PARALLEL LAYERS OR FOR ASSEMBLING TUBES ON THICK WALLS. (to Societe Babcock-Atlantique). French Patent 2,121,990. 25 Aug 1972. Filed date 14 Jan 1971. 13p. (In French).

A process is presented for the manufacture of metallic walls such as those of very thick cylindrical or semi-spherical skirting. A framework is formed with the two elements to be joined. They are assembled with a predetermined gap between them, an open enclosure being formed in the upper part. An insulated composite electrode having a fused guide wire is positioned in this enclosure. An arc is then initiated in the lower part of the enclosure and the weld effected from the bottom towards the top using the metal from the electrode and a filament supplying the filler metal. A single block multilayer part is thus obtained. In this way, it is possible to manufacture the envelopes of installations operating at very high temperature such as nuclear reactor vessels. (FR)

23673 TOP FOR NUCLEAR REACTOR REINFORCED CONCRETE PRESSURE VESSEL. Eggeler, E.; Stueger, R. (to Siemens AG). German Patent 1,684,926. 15 Apr 1971. Filed date 16 Mar 1967. (In German).

A top for reinforced concrete reactor pressure vessels with exterior conical surface for framing the supports corresponding to the form of a wedge on the cover of the cylindrical pressure vessel is characterized by the fact that the top consists of several sectors with grooves between them. (TSS)

23674 COOLING TOWERS FOR POWER PLANTS TO SOLVE THE THERMAL POLLUTION PROBLEM. Shinohara, H.; Yamada, M.; Sakamoto, Y. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo). Ishikawajima-Harima Giho; No. 5, 121-133(May 1973). (In Japanese).

Interest is increasing in the thermal pollution problem caused by large amounts of hot waste water being discharged from power plants. Cooling towers for power plants are a most effective and economical means of solving this problem and the cooling system using such towers has several advantages over the once-through cooling system. Thus the total power generating cost is economical where plant locations or design conditions are settled. The characteristics and economics of cooling towers for power plants are shown and compared with other cooling systems. Several problems in the planning stage are examined and the general feature of IHI-ECODYNE cooling towers are described. An outline of IHI's own new development of cooling towers for power plants are discussed. (auth)

23675 PRODUCTION OF PLANE SURFACE ELEMENTS MADE OF CONCRETE. Borsdorf, H. German Patent 1,919,505. 29 Oct 1970. Filed date 17 Apr 1969. (In German).

Procedures for the production of plane surface elements of concrete with narrow fabrication tolerances for use in building protective reactor walls are described. (TSS)

23676 SPECIAL CHARACTERISTICS OF ION-EXCHANGE MATERIALS IN NUCLEAR ENGINEERING. Kuehne, G. (Farbenfabriken Bayer AG, Leverkusen, Ger.). (1972). vp. (In German).

From VGB conference on chemistry in nuclear power plants; Essen, Germany (10 Oct 1972).

By means of diagrammatic sketches showing the basic operating principle of various types of nuclear power plants (in Europe and in other countries), different procedures of water treatment, mainly referring to complete demineralisation and filtration (make-up water, cooling water, primary cooling circuit, storage tank, secondary cooling circuit, blowdown water, condensate, leakage water, evaporator condensate, waste water and decontamination in general) are discussed. The requirements from the technical and chemical point of view are compared to currently available ion-exchange and filtration materials, whose properties are mainly assessed by the following criteria: resistance against mechanical, osmotic, thermal and chemical effects, as well as their radiosensitivity; degree of purity after one pass or after regeneration and recycling; absorptive power with respect to impurities in the water and lowest possible amounts of residual impurities. One of the main factors leading to the application of a certain treatment procedure is its efficiency which can be increased by using the same method in the overall plant. Environmental conditions play an important part in the use of spherical ion-exchange resins and in the choice of certain regeneration methods and in alluvial filtration. (GE)

23677 LIFTING DEVICE FOR THE TOP OF A NUCLEAR REACTOR PRESSURE VESSEL. Scholz, M. (to Siemens AG). German Patent 1,960,368. 6 May 1971. Filed date 2 Dec 1969. (In German).

This lifting device is characterized by a crossbeam with several arms connected to the cover of the reactor by means of extension rods equipped with gages for determining the load and with suspension for the universal joint on the crane hook and with adjustable extension pieces under pressure for equalizing the differences with regard to the horizontal in at least two points of application.

23678 MANIPULATING TOOL FOR A NUCLEAR REACTOR COMPONENT PROVIDED WITH A HANDLE. Suvanto, A.; Nilsson, H. (to Aktiebolaget Asea-Atom). U. S. Patent 3,720,436. 13 Mar 1973. Priority date 21 Apr 1969, Sweden. 12p.

A manipulating tool for nuclear reactor components, such as a shroud tube having holes in its upper end, fuel rod bundles, a control rod provided at its upper end with a handle, or a complete fuel assembly having a bundle in a shroud tube is described. The tool is formed of two crossing legs pivoted together and connected at their upper end to an operating member. The legs have first and second hooks for simultaneous engagement in the holes and in the handle respectively, and oppositely directed third hooks for engaging in the handle only. (Official Gazette)

23679 APPARATUS FOR FACILITATING REMOVAL OF MODERATOR BLOCKS FROM A NUCLEAR REACTOR BY TILTING THE BLOCK SUPPORTING BASE PLATES. Waldis, J. (to Aktiengesellschaft Brown, Boveri and Cie). U. S. Patent 3,728,221. 17 Apr 1973. Priority date 29 May 1970, Switzerland. 4p.

In a nuclear reactor, columns of stacked moderator blocks are arranged in side-by-side relation. To facilitate removal of the moderator blocks, each column is supported upon a base plate which is arranged to be tilted from its normal vertical position by means of a piston arrangement so as to separate the blocks in one column from those in an adjacent column. (Official Gazette)

23680 DRIVE DEVICE FOR ROTATABLE REACTOR PLUG. Brandstetter, R. (to Commissariat a l'Energie Atomique). French Patent 2,129,852. 17 Mar 1971. 7p. (In French).

The rotatable plug used for closing the orifice of a nuclear reactor vessel is described. The body of the plug is provided around its periphery with an edge which presses against the race of a bearing attached to a fixed support (which may be the wall of the vessel containing the reactor core). The periphery is fixed to the tubular ring with a flange attached by a screw. The outer face of the ring is provided with an annular dishing which is traversed at regular intervals by shafts supporting the links of a

transmission chain. These links are driven by a gear wheel attached to a rotating shaft driven by a second gear wheel and a worm gear connected to a motor assembly (equipped with a progressive clutch and a speed reduction gear). The driving of the ring is ensured without deterioration of the teeth of the wheel or the links of the chain. Several identical devices can be positioned at different positions around the ring, thus equilibrizing the reactions on the plug. (FR)

23681 MOTORIZED VALVE ACTUATORS FOR NUCLEAR POWER PLANTS. Gregory, B. Nucl. Eng. Int.; 18: No. 207, 631-633(Aug 1973).

Increasing evidence of valve malfunction in nuclear power plants has led to new standards being developed for valve actuators. To achieve the necessary reliability the design, quality assurance, manufacture and applications must be considered as an integral group. The importance of each of these criteria is discussed. (UK)

23682 NUCLEAR VALVES. Nucl. Eng. Int.; No. 207, 634 (Aug 1973).

A data sheet of suppliers of valves for the nuclear industry, listing the range and operating parameters of valves offered and the capacities and capabilities of the manufacturing facilities, is presented. (UK)

Reactor Fuels

Refer also to abstracts 20845, 21013, 21016, 21332, 21434, 21881–21884, 21955, 22059, 23367, and 23613.

23683 (HEDL-TME-73-50) DATA REDUCTION PROGRAMS FOR PORE SIZE ANALYSIS. Treibs, H. A. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-2170. 166p. AT.

Computer programs for the estimation of the pore size distribution of nuclear fuel pellets are listed and described. The estimate is based on measurements of a series of micrographs made over a range of magnifications by optical and electron microscopy of polished plane sections of fuel pellets. The images of pores on the micrographs are measured either visually with a Zeiss-Endter Particle Size Analyzer or automatically with a Quantimet 720 Image Analysis System. The pore size distribution for micrographs at each magnification is estimated separately, and the segments thus obtained are combined by a least squares polynomial fitting technique. An example of the use of the programs is included. (auth)

23684 (MRR-94) COMPILATION OF THE EXPERIMENTALLY ANALYZED RELEASE PHENOMENONS OF FISSION PRODUCTS FROM REACTOR FUELS IN DEPENDENCE ON TEMPERATURE. Simon Weidner, J. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Nov 1971. 97p. (In German). INIS.

Many extensive experiments were performed between 1955 and 1970 to measure fission gas release from reactor fuels. All these releases depend to a high degree upon numerous parameters as, for example, temperature, density of fuel, irradiation, kind and flow rate of atmosphere, and heating times. Only a few experiments were made with stainless steel or Zircaloy cladded material. In general, there is a lack in subdividing release into momentary and continuous releases respectively in graphs of time dependent fission gas releases. As far as this problem is concerned, intensified research should be performed in the near future. (INIS)

23685 (RD/B/N-2633) FISP 4 AND HYLAS 2: UPDATED VERSIONS OF THE COMPUTER PROGRAMS FOR CALCULATING RADIOACTIVE FUEL INVENTORIES. Beynon, S. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Apr 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

Descriptions are given of the current versions of the FISP program for fission product inventories, and the HYLAS program for heavy element build-up in irradiated nuclear fuel. FISP has been updated to include new data libraries of fission product yields and decay schemes. In addition the program contains three energy group neutron capture cross-sections and follows some 50 capture chains of significance. HYLAS now has 16 (n,2n) reactions and the 54 isotopes included range from ^{228}Th to ^{246}Cm. The methods of solution used in the programs remain as previously reported, but a significant amount of reprogramming has been necessary to include the new data and attempts have been made to make the programs easier for the user to run. (auth)

23686 (SGAE-2097) INFLUENCE OF UNCERTAINTIES IN FISSION PRODUCT NUCLEAR DATA ON THE INTERPRETATION OF GAMMA-SPECTROMETRIC MEASUREMENTS ON BURNT FUEL ELEMENTS. Eder, O. J.; Lammer, M. (Oesterreichische Studiengesellschaft fuer Atomenergie G. M. B. H., Seibersdorf). Feb 1973. 45p. (SM-170/12). Dep. NTIS (U. S. Sales Only) $4.25.

The combination of computer calculations and gamma spectrometric measurements offers new possibilities for investigations on burnt fuel elements. The accuracy of such a method is mainly limited by the accuracy of nuclear data used and uncertainties in the evaluation of measured gamma spectra arising from experimental conditions. A method is described that combines "forward" calculations and measured activity ratios of fission products and examples of application are given. The availability of compilations of nuclear data relevant for burnt fuel element analysis is surveyed and improvements are proposed. A set of fuel isotope and fission product nuclear data is presented, that resulted from our own compilation efforts. Finally uncertainties are reviewed that arise from detector calibration, experimental conditions, nuclear data of fission products and simplifications in calculations. The influence of uncertainties in nuclear data on results of calculations and measurements is demonstrated by some examples. (auth)

23687 (SRARI-P-166) STUDY OF INFLUENCE OF THE EFFECTIVE FUEL DENSITY AND THE CORE SINTERED PELLET DENSITY ON THE DIMENSIONAL STABILITY OF THE FAST REACTOR UO_2 FUEL ELEMENTS. Lebedev, I. G.; Golovnin, I. S.; Kuz'min, V. I.; Bibilashvili, Yu. K.; Sytov, L. I.; Piskun, A. S.; Matveev, N. P.; Kalashnik, G. V.; Petukhov, A. A. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The investigation results on the irradiation in CM-2 reactor to 5–8% burnup of heavy atoms and of the investigation of the experimental fuel elements for the fast reactors with UO_2 fuel are given. The data on the cladding diameter changes, gas release and structural changes of the fuel element core with different initial effective fuel densities, the sintered pellet densities and the gap between the core and the cladding are obtained. Based on the investigation results the conclusion was drawn about the possibility of using the fuel elements with the effective fuel density up to 9.0 g/cm^3 in fast reactors at the maximum specific linear loads up to 500 wt./cm and at 8 at. % and higher burnups. (auth)

23688 (SRARI-P-179) EVALUATION OF RADIATION CHARACTERISTICS OF REGENERATED PLUTONIUM FUEL. Anufriev, V. A.; Gavrilov, V. D.; Ivanenko, V. V.; Krasnoyarov, N. V. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The calculational results on radiation characteristics of regenerated plutonium fuel are presented. Dose rates have been estimated for thermal reactor fuel elements of fast reactor blanket and core. The calculational methods have been tested on a plutonium specimen of a known isotopic composition. The experimental and calculational data are in good agreement. 4 references. (auth)

23689 URANIUM INDUSTRY AND NUCLEAR FUEL REQUIREMENTS FORECASTS IN PORTUGAL. Com. Naz. Energ. Nucl., Notiz.; 19: No. 5, 66-70(May 1973). (In Italian).

Portugal ranks third, after France and Spain, among the European countries possessing proven uranium reserves. The various sectors of activity relating to uranium, from prospecting to fuel fabrication are reviewed and forecasts are made as to future requirements. (auth)

23690 DIFFUSION OF RARE FISSION GASES THROUGH THE FUEL ELEMENT CLADDING. Boeck, H. (Oesterreichische Hochschule, Vienna). Atomkernenergie; 21: No. 3, 189-191(1973). (In German).

The diffusion of fission gases through the fuel element cladding was investigated. The calculations were performed for the fuel elements of a research reactor (TRIGA) as well as for dimensions of fuel pins of light water cooled reactors (PWR and BWR) and can be adapted to any cylindrical fuel element when proper cladding dimensions are used. (GE)

23691 FABRICATION OF FUEL ELEMENTS FOR LIGHT-WATER-COOLED REACTORS IN EUROPE. At. Inform.; No. 2, 4-5(1973). (In German).

A survey is given of the European firms and establishments associated with fuel element fabrication. Their total manufacturing capacity is compared to the projected fuel element demands up to the year 1985. (GE)

23692 FUEL ELEMENT FOR NEUTRONIC REACTOR AND METHOD OF FABRICATION THEREOF. Franco-Ferreira, E. A. (to United States Atomic Energy Commission). Australian Patent 427,728. 30 Aug 1972. Priority date 29 Mar 1968, United States of America (USA).

A pin-type fuel element used in nuclear reactors is described. Substantially cylindrical fuel pins are deformed at one end into rectangular cross sections and bonded together along their deformed ends. The undeformed portions of the fuel pins are maintained in a spaced apart relationship to facilitate coolant flow. (AEC)

23693 METHOD OF PREPARING FUEL PLATES FOR A NUCLEAR REACTOR. Handwerk, J. H.; Durek, J. T.; White, G. D. (to United States Atomic Energy Commission). Australian Patent 429,467. 10 Oct 1972. Priority date 2 May 1968, United States of America (USA).

A method of fabricating large numbers of thin flat fuel plates of uniform density and thickness for use in a nuclear reactor is described. Accurately weighed increments of a ceramic powder are added to a vertical graphite die, each increment is leveled and a thin graphite spacer inserted between increments. The die is heated under high pressure. (AEC)

23694 VENTED FUEL PIN. Germer, J. H. (to United States Atomic Energy Commission). Australian Patent 429,535. 26 Oct 1972. Priority date 24 Jul 1968, United States of America (USA).

A device is incorporated in the upper end of a vented type nuclear fuel element which permits outward leakage of fission product gases and prevents inward leakage of coolant. This is accomplished by venting gases to the upper end of the fuel pin which is at a lower external pressure than in the vicinity of the bottom of the plenum. In addition, venting at the top of the plenum eliminates a coolant level variation in the plenum caused by pressure variations. The device includes means for preventing air and moisture from getting into the fuel element and fuel from escaping during initial handling. (AEC)

23695 NUCLEAR FUEL ROD HAVING AN OFFSET PLENUM. Hines, D. P. (to United States Atomic Energy Commission). Australian Patent 431,865. 10 Jan 1973. Priority date 10 Oct 1968, United States of America (USA).

A nuclear fuel rod has an offset plenum which reduces the coolant pumping requirements from the conventional plenum configuration and comprises at least one fuel rod having a fuel section near the lower end and a fission product gas plenum section near the upper end. The plenum section includes an offset portion at the lower end. The offset portion is configured to place the plenum sections of the fuel rods of a fuel cluster in contiguous array and place the fuel section of the rods in ordered spaced arrays due to the axis of the plenum section with respect to the axis of the fuel section. (AEC)

23696 REACTOR CORE RADIAL LOCKING DEVICE. Stankiewicz, R. S. (to United States Atomic Energy Commission). Australian Patent 430,120. 2 Nov 1972. Priority date 2 Jul 1968, United States of America (USA).

A device for locking together the fuel assemblies in a nuclear reactor is described. A retaining band is provided which is made of material having a lower coefficient of thermal expansion than the core structural material so that the fuel assemblies are loosely held at shutdown and locked against movement at operating temperature. (AEC)

23697 VERIFICATION OF ENERGY RELEASE IN FISSION FROM POWER PLANT CALORIMETRICS AND ISOTOPIC COMPOSITION OF SPENT FUEL. Jedruch, J.; Nodvik, R. J. (Westinghouse Electric Corp., Pittsburgh). J. Nucl. Energy; 27: No. 4, 195-225(Apr 1973).

The reactor of a nuclear power station was treated as a flow calorimeter to evaluate the energy released in fission from a given loading of UO_2. The changes in the inventories of U and Pu isotopes were obtained from reprocessing of the spent fuel and the corresponding total number of fissions was determined. The resulting energy released per average fission in a fuel irradiated to 11.5 GWD/MTU was found to be 203.2 ± 6.0 MeV from batch isotopic method, 204.6 ± 6.3 MeV from batch composite method and 204.8 ± 7.2 MeV from ^{148}Nd analyses. For burnups both higher and lower than this value, the results indicate the presence of a burnup dependence somewhat greater than that expected on the basis of Pu buildup alone. The accuracy of the plant data was found to be limited by the ability to measure the steam generator feed water flow rates. (auth)

23698 DEVELOPMENT OF BURNUP DETERMINATION TECHNIQUE BY DESTRUCTIVE MEASUREMENT. Natsume, H.; Okashita, H.; Umezawa, H. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 4, 239-247 (Apr 1973). (In Japanese).

The system for burnup measurements of spent nuclear fuel adopted in the Japan Atomic Energy Research Institute is outlined, and the procedure for destructive measurements is described in detail. In this procedure, various determinations by γ-ray and α-ray spectrometry, coulometry and mass-spectrometry are systematically employed after sequential ion-exchange separation. Treatment of the data and the method of analysis for burnup evaluation are also discussed. A description is also given of the present status of installations of the Burnup Measurement Cell, and some results obtained from test runs are presented. (auth)

23699 NUCLEAR REACTOR FUEL ELEMENT SPACER ASSEMBLY. Eggert, W. K. (to Continental Oil Co.). U. S. Patent 3,751,335. 7 Aug 1973. Filed date 1 Jun 1970. 6p.

A nuclear reactor fuel element spacer arrangement has a fuel element supporting and spacing means in the form of individual cells through which respective fuel rods extend. The cells have a number of sides, some of which are provided with leaf spring members protruding into the cell and others of which are provided with knobs such that the fuel rod in each cell is resiliently gripped between the springs and the knobs in a manner to restrict lateral motion of the fuel rods. (Official Gazette)

23700 FUEL BUNDLE WITH REMOVABLE RODS. Qurnell, F. D.; Ikemoto, R. N.; Lass, J. L. (to General Electric Co.). U. S. Patent 3,741,868. 26 Jun 1973. Filed date 30 Mar 1970. 6p.

A removable rod arrangement for the fuel bundle of a nuclear reactor core is described which provides ready insertion and removal of the removal rods without disassembly of the fuel bundle. The removable rods are accurately positioned by complementary positioning surfaces and retained in position by a spring-loaded, tapered pin and pin seat. (Official Gazette)

Reactor Control Systems

Refer also to abstract 21878.

23701 (AEEW-R-829) CONTROLLABILITY AND OBSERVABILITY CONSIDERATIONS IN THE DESIGN OF SECTOR CONTROL CONFIGURATIONS FOR CYLINDRICAL NUCLEAR POWER REACTORS. Owens, D. H. (Atomic Energy Establishment, Winfrith (England)). May 1973. 50p. Dep. NTIS (U. S. Sales Only) $4.50.

The system theory concepts of controllability and observability are used to derive mathematical conditions on the number of sectors and the control and observation distributions in each sector for a sector control configuration for the control of the azimuthal xenon-driven modes of a cylindrical nuclear power reactor. (auth)

23702 (MRR-109) POSSIBLE CAUSES OF FAILURE OF HYDRAULIC VALVES AND THEIR CONSIDERATION IN FAULT TREE ANALYSES. Hoertner, H. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Dec 1972. 34p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

A survey of possible modes and causes of failures concerning hydraulic valves is given. Failure rates for commanded failures are shown. Particular emphasis is given to the problem as to how to deal with the possible failure modes of valves in fault tree analyses. The investigations are based on the SIMATIC P control systems used for reactor protection in nuclear power plants. (GE)

23703 (NP-19812, pp 23-53) AUTOMATION OF NUCLEAR POWER PLANTS. Handschuh, H. May 1973. (In German).

KWU has extended its automation philosophy developed for conventional power stations into the field of nuclear power plants. This rejects the use of a centralized programmable, digital computer based system in favor of a decentralized, fixed wiring, electronic system. The plant is divided into separate functional groups, each with an independent central control unit. This performs both regulating and coordinating functions and includes safety actions and data processing and alarm actions. An example of the time saved by this procedure is given in the automatic start of the function group "ventilation system" which takes 12 minutes, as compared to 80 minutes for manual start. (NO)

23704 (PTB-FMRB-46) ^{16}N POWER CONTROL SYSTEM OF THE FORSCHUNGS- UND MESSREAKTOR BRAUNSCHWEIG (FMRB). Viehl, E. (Physikalisch-Technische Bundesanstalt, Brunswick (West Germany)). Jun 1971. 23p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

The ^{16}N power control system installed in the FMRB differs from similar systems in other reactors in that it has an additional bypass for the primary coolant flow, at which the ^{16}N activity is measured. The dependence of the indicated ^{16}N power on variations in the primary coolant flow containing two cores as well as on operating conditions of the reactor are discussed. (GE)

23705 (WCAP-7778) SOLID STATE ROD CONTROL SYSTEM FULL LENGTH. Blanchard, A.; Katz, D. N. (Westinghouse Electric Corp., Pittsburgh, Pa.). [nd] 50p. Dep. NTIS $4.50.

The increased core size of present Westinghouse Pressurized Water Reactors required the use of control rod drive mechanisms capable of moving heavier fuel assemblies at faster speeds. The resultant increase in power demands and transient switching requirements, starting with the Ginna plant, exceeded the capabilities of the electro-mechanical control systems used on previous plants. However, they could be readily and reliably satisfied with solid state electronic equipment. A functional description of the solid state rod control system used for operating the full length rods in present generation Westinghouse Pressurized Water Reactors is presented. By using a modular concept, the major sub-assembly designs have been standardized and as such they are readily combined into standard systems satisfying the requirements for two, three, and four loop plants. Detailed descriptions of the major sub-assemblies which comprise the system, the operational features of these sub-assemblies, and the overall operational capabilities of the entire rod control system are presented. The information provided covers the full length rod control system for two, three, and four loop Westinghouse Pressurized Water Reactors. (auth)

23706 (WCAP-7811) POWER DISTRIBUTION CONTROL OF WESTINGHOUSE PRESSURIZED WATER REACTORS. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1971. 119p. Dep. NTIS $8.00.

As a result of the current trend in reactor design towards larger cores having high power density, the probability that xenon-induced spatial power oscillations will occur is increased. The provisions made in Westinghouse reactors for the detection and control of these oscillations are described. Typical operating procedures and protection systems are described which ensure continuous safe operation of the plant and prevent the occurrence of unacceptable power distributions. (auth)

23707 CORROSION SURVEILLANCE SYSTEM. Kolodney, M.; Arbiter, W. (to United States Atomic Energy Commission). U. S. Patent 3,734,690. 22 May 1973. Filed date 28 Apr 1970. 8p.

An on-line corrosion surveillance system for monitoring corrosion damage to a structural component containing a corrosive liquid wherein a fine control element is, during operation, drawn longitudinally through the structural component and subsequently measured for corrosion damage due to its exposure to the corrosive liquid within the component. The control element is made of the same material as the structural component and specially constructed sealing means is provided for preventing escape of the corrosive liquid from the component as the control element is moved through. (Official Gazette)

23708 SPACE–TIME CONTROL OF NUCLEAR REACTOR DYNAMICS. de Barros Fonseca, G. M. Stanford, CA; Stanford Univ. (1973). 121p. University Microfilms Order No. 73-14,896.

Thesis (Ph. D.).

A new approach to the analysis and design of a regulator for the axial neutron flux distribution in a nuclear reactor system is introduced. The basic idea is the application of a linear transformation to the reactor dynamics such that the directly measurable state (axial neutron flux) is not changed by the transformation. If a modal analysis is used in the transformed dynamics, the mode couplings, due to the non-uniform spatial xenon distribution, will be transformed into a special structure, which will allow the basic contributions of this work: a. a sufficient condition for the controllability of N natural modes in the presence of a non-uniform xenon distribution, b. necessary and sufficient conditions for the stability of N natural modes, in terms of lower order matrices, via an extension of the Routh–Hurwitz stability criteria or the location of the roots of det $P(s) = 0$, where $P(s)$ is an integer polynomial in s with matrix coefficients. The design of a regulator for the axial flux distribution has the following desirable features: (1) A feedback law is obtained to decouple the spatial control from the power control, so that the spatial control does not affect the reactor power level; and (2) A feedback law is obtained to force the amplitudes of the modes to zero, with time constants selected under the constraint of maximum allowable control rod displacements. (Diss. Abstr. Int., B)

23709 USE OF ON-LINE PROCESS COMPUTERS FOR MALFUNCTION DIAGNOSIS AND FAULT DETECTION IN NUCLEAR POWER PLANTS. El Ashmawi, F. M. · Raleigh, NC; North Carolina State Univ. (1972). 182p. University Microfilms Order No. 73-13,912.

Thesis (Ph. D.).

The on-line process computer functions necessary to assist nuclear power plant operators during abnormal transient conditions are defined. Analysis of possible causes of deviation in critical plant parameters for malfunction and fault detection has been made. Computer methods and flow charts for on-line application are presented. Expected malfunctions and faults in nuclear power plant systems and their symptoms are analyzed. On-line computer monitoring and methods for detection of the occurrence of these faults are presented. Computer application for detection and distinction between three of the possible major accidents (loss of coolant, steam line break, steam generator tube rupture) is proposed. Computer aid following a plant trip is based on plant trip diagnosis for both the initial and final causes. Plant trip confirmation and operational aid during trip recovery and blackout situation are supported by use of a cathode ray tube alarm and message display unit. Use of CRT for information and alarm display presents a major feature in communication between the operator-computer-plant. Present computer availability time, speed, and storage could satisfy the requirement of the proposed computer aid to support the safety of the plant. The proposed computer functions, analysis developed and technique proposed could establish a basis for a complete direct safety protection system based on early and proper fault detection and optimum safety action by on-line process computers. (Diss. Abstr. Int., B)

23710 AUTOMATIC CONTROL OF THE VANDELLOS NUCLEAR POWER PLANT. Gheeraert, P. (Societe d'Etudes Techniques et d'Enterprises). Ind. At. Spatiales; 17: No. 1, 31–46 (Jan 1973). (In French and English).

The Vandellos Power Plant, installed on the Mediterranean shore some 40 km south of Tarragona, was constructed on a turnkey basis by a group of French constructors for Hispano-Francesa de Energia Nuclear S.A. The 500 MW(e) power plant is operated from a single control room. Its automatic functioning is ensured by a two-computer system simultaneously handling 4700 digital information units and 1900 measurements from the power plant; only the pilot computer sends out orders to the relay system and for control purposes together with providing information for the operator. This high level automation has been achieved using a functional subdivision of the power plant. As a result a detailed study of the elementary functions was effected. The AUTOL specialized language is used. (FR)

23711 PNEUMATIC SCRAM ROD DRIVE. Germer, J. H. (to United States Atomic Energy Commission). Australian Patent 431,825. 5 Jan 1973. Priority date 8 Aug 1968, United States of America (USA).

A single purpose drive withdraws an individual control rod from the core of a nuclear reactor and holds it in a cocked position in a cylinder until a scram signal is received. The control rod is withdrawn and held in the cocked position by a vacuum pump arrangement and upon a scram signal is driven into the core by a high pressure fluid, such as argon, acting on a piston. Simplicity and reliability as well as inherent fail-safe features are provided with no critical sliding seals or secondary fluids employed. (AEC)

23712 DRIVE FOR THE CONTROL ROD OF A NUCLEAR REACTOR. Acher, H. (to Licentia Patent Verwaltungs GmbH). German Patent 1,950,646. 22 Apr 1971. Filed date 8 Oct 1969. (In German).

A control rod drive for water-cooled reactors where a mechanical drive is combined with a hydraulic or pneumatic drive so that the absorbing part of the control rod is introduced rapidly into the core by hydraulic or pneumatic discharge and in normal operation is regulated with precision by the aid of mechanical means is described. Distinguished by precision adjustment, the piston cavity is formed by a screw above the collar and is assured against torsion by this means. An advancing device analogous to a screw nut composed of a cylindrical lever drives the piston cavity. The device is placed in the pressure vessel of the reactor and is placed in rotation by precision control. (TSS)

23713 COUPLING MECHANISM FOR CONTROL RODS OF NUCLEAR REACTORS. Obenauf, E. (to Licentia Patent Verwaltungs GmbH). German Patent 1,952,851. 29 Apr 1971. Filed date 21 Oct 1969. (In German).

23714 SHUT-DOWN APPARATUS FOR NUCLEAR REACTORS. Greenhalgh, F. G.; McLaren, N. H. (to United Kingdom Atomic Energy Authority). British Patent 1,313,188. 11 Apr 1973. Filed date 16 Oct 1970. 12p.

An apparatus is described for installation in a tubular extension to a vertical channel of a reactor core consisting of a latch mechanism for releasing a number of neutron absorbing balls from a valved container into the reactor core on receipt of an emergency

signal. The latch mechanism is responsive to a pressure sensitive means comprising a flexible capsule within a chamber whose interior pressure follows reactor coolant pressure with a lag compared with the capsule interior, which communicates with the reactor coolant. The arrangement is such that, in response to a pre-selected rate of fall of reactor coolant pressure, the capsule deforms to release the latch mechanism. Greater reliability is achieved by the use of balls instead of solid rods, since injection into the bore in an emergency is less likely to be prevented by distortion of the reactor channels. Preferably a passage restrictive to fluid flow, such as capillary tubing, communicates between the interior and exterior of the capsule. (UK)

23715 HYDRAULIC VALVE IN NUCLEAR REACTOR. Ripley, C. C. (to United States Atomic Energy Commission). Australian Patent 427,964. 5 Sep 1972. Priority date 24 Jul 1968, United States of America (USA).

A valve, in combination with a control-rod drive assemoly, for use in a liquid-metal cooled reactor is described. The valve consists of an inlet passageway for a primary electrically conductive fluid. The passageway terminates in a passageway with a smaller cross section creating a jet-like effect. A pair of outlet passageways connected to the opposite end of the chamber defines a γ configuration. The valve applies fluid pressure to the control rod for control rod movement. (FS)

23716 BACKUP CONTROL ROD SYSTEM. Germer, J. H. (to United States Atomic Energy Commission). Australian Patent 430,335. 8 Nov 1972. Priority date 16 Jul 1968, United States of America (USA).

This invention is a backup control rod arrangement which functions to shut down a nuclear reactor in the event of failure of the primary control system. During normal operation of the reactor, the backup control rod is maintained in a position beneath the reactor core by suction produced by an electromagnetic pump or the like. Upon failure of the primary control rod to move downward in tube into core upon scram conditions or other desired shut down of the reactor, the pump is reversed or inactivated and the backup control rod is forced upwardly into core or allowed to float upwardly in tube into the core due to the backup rod being less dense than the coolant, such as sodium, in the core. (AEC)

23717 MULTIVARIABLE MEASUREMENTS OF THE REACTIVITY EQUIVALENT OF CONTROL RODS. Serizawa, M.; Natori, H. (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 3, 133-138(Mar 1973).

The reactivity equivalent of control rods was measured by three-variable measurements. The reactivity of a core was measured upon simultaneous displacement of two control rods from a critical point. The worth of one of the control rods, when the other was not displaced from the critical point, could be obtained by data processing. The results are compared with those from two-variable measurement, in which the reactivity change is determined by the summation of a series of small changes. The results agreed very well between those of the three-variable and the two-variable measurements. The differences were within ±5%. The present experimental procedure is much simpler than required for the currently practiced two-variable measurement. (auth)

23718 COMPARATIVE ANALYSIS OF SOME STRUCTURES OF THE AUTOMATIC POWER CONTROL SYSTEM OF A NUCLEAR REACTOR. Egorov, K. V.; Rikhter, R. Tr. Mosk. Energ. Inst.; No. 95, 79-83(1972). (In Russian).

Some variations are compared of the structures of the automatic power control system of an atomic power plant with a nuclear reactor based on fast neutrons with a sodium coolant. Analysis of the results showed that the structure and coefficient of the regulator of the vapor temperature has little effect on the quality of regulation of the pressure and it is theoretically possible to regulate the parameters of the vapor preceding the turbine, and the parameters of the nuclear reactor are independent of one another. The most acceptable automatic power control system of a nuclear reactor for an atomic power plant is recommended. (JPRS)

23719 APPLICATION OF ON-LINE DIGITAL NOISE ANALYSIS TO REACTOR DIAGNOSIS IN JMTR. Izumi, M. (Hitachi Ltd., Japan); Iida, H. J. Nucl. Sci. Technol. (Tokyo); 10: No. 4, 227-233(Apr 1973).

The reactor noise analysis technique is particularly useful in reactor diagnosis for on-line monitoring if the raw noise signals can be processed in almost real time. An on-line reactor noise analysis system has been developed using a mini-computer HITAC-10. This system utilizes functions for calculating the power spectral density in almost real time, plots the output by digital incremental plotter, and displays the results by means of color graphic display equipment, in order to detect anomalous reactor conditions with the statistical technique. Using this system, reactor noise signals have been measured and analyzed under various operational conditions in the JMTR. The variance of the power spectral density is found to fit a logarithmic probability density function. This function is independent of the frequency, but is dependent on the number of sampling functions. A logical procedure for anomaly detection based on statistical characteristics has been developed. It is applied to a case where it is supposed that the PWR operating mode in the OWL-1 is the normal process and that the BWR mode is the anomalous. It is demonstrated that this procedure can successfully detect anomalous processes. (auth)

23720 SEARCH TECHNIQUE FOR CONTROL ROD PATTERN FOR SMOOTHING CORE POWER DISTRIBUTIONS BY FUZZY AUTOMATON. Serizawa, M. (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 4, 195-201(Apr 1973).

A new search technique for using a fuzzy automaton, which was developed for determining a desirable rod pattern for smoothing the core power distribution is discussed. Using the algorithm thus developed, the optimal input vector applied to a controlled system whose characteristics are unknown is determined automatically from a learning operation of the fuzzy automaton when an initial guess and a hypothetical range of optimal input vector are given. The characteristics of this algorithm are examined for an example of its application to a simple problem. The optimal control rod pattern for smoothing the core power distribution is also determined by this algorithm in a simulation study using the three-dimensional boiling water reactor simulator "FLARE." It is concluded that optimum points are obtained with sufficient convergence and with only a small increase in the number of iterations and computation time accompanying an increase in the number of components of the input vector. The predicted optimal control rod pattern in the simulation study can be considered reliable. (auth)

23721 RAPID DISCONNECTION CLUTCH FOR NUCLEAR REACTOR CONTROL RODS. Pawlitzki, R. (to Siemens Aktiengesellschaft). U. S. Patent 3,721,462. 20 Mar 1973. Priority date 19 Jun 1969, F. R. Germany. 6p.

Stop balls removably couple a control rod linkage to a clutch piece. The clutch piece is movably mounted in a guide member. The guide member includes releasing means for releasing the stop balls and thereby decoupling the control rod linkage from the clutch piece when the clutch piece moves to a determined position. (Official Gazette)

23722 INSTRUMENTATION FOR NUCLEAR REACTOR CORE POWER MEASUREMENTS. Musick, C. R.; Remshaw, R. P. (to Combustion Engineering, Inc.). U. S. Patent 3,752,735. 14 Aug 1973. Filed date 16 Jul 1970. 12p.

In a nuclear reactor system, at least two independent measures of reactor core power are provided with one being dependent on neutron flux and the other on coolant thermal parameters. The two independent measures of core power are interrelated in a manner which exploits the advantages of each while avoiding inherent limitations of either to provide a more accurate determination of core power for a variety of system conditions. (Official Gazette)

23723 CONTROL ROD DRIVE SYSTEM. Fortescue, P. (to Gulf Oil Corp.). U. S. Patent 3,741,867. 26 Jun 1973. Filed date 15 Jun 1971. 8p.

A control rod drive system for a nuclear reactor is described in which a flywheel is used to absorb kinetic energy of the control rod and associated elements near the end of a scram stroke. In this manner, braking of the control rod is accomplished without producing undue stress therein and in the associated elements. (Official Gazette)

23724 CHOICE OF PHYSICAL WEIGHT OF POISON RODS FOR PROTECTION AGAINST EXCEEDING A SET POWER LEVEL. Sarkisov, A. A.; Puchkov, V. N.; Melnikov, B. A. At. Energ. (USSR); 34: No. 6, 441-444(Jun 1973). (In Russian).

The possibility of improving the quality of a transition process when the emergency protection system is actuated by a signal indicating that the set power level has been exceeded is considered. It is proposed to entrust functions of protection to absorbing rods of a reserve regulator of small physical weight. An approach to the determination of the physical weight of these poison rods has been worked out. (auth)

Nuclear Power Plant Economics

23725 (FRNC-CONF-86) GENERAL EVOLUTION OF INTERNATIONAL COOPERATION. Technical and Economic Aspects. Hannothiaux (Electricite de France, Paris). 1973. 11p. (In French). (CONF-730341-6). Dep. NTIS (U. S. Sales Only) $3.00.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

The program of the French Electricity board concerning the production of electricity of nuclear origin is presented and problems associated with the supply of enriched uranium are discussed. (FR)

23726 (NP-19776) WORLD NUCLEAR POWER: STATUS, TRENDS, AND MARKETS. (Interdevelopment, Inc., Arlington, Va. (USA)). Apr 1973. 226p. Interdevelopment, Inc., Arlington, Va. (USA).

Information on the worldwide development of nuclear power plants is presented concerning central power station economics, fuel processing and fabrication, research and development, organizations, status and trends, and the nuclear market. (DCC)

23727 (NP-19812) LECTURES, AUTUMN 1972–SPRING 1973. (Norsk Atomenergiforening, Oslo). May 1973. 89p. (In Several Languages). Dep. NTIS (U. S. Sales Only) $6.50.

Information on nuclear fuel reprocessing and nuclear power plant development is summarized. Separate abstracts are included for each of the 4 papers presented. (DCC)

For abstracts of individual papers see: 20885, 23442, 23703, and 23728.

23728 (NP-19812, pp 54-69) SCANDPOWER: NORWEGIAN CONSULTANT FIRM IN THE INTERNATIONAL NUCLEAR POWER MARKET. Ager-Hanssen, H. (Scandpower A/S, Kjeller, Norway). May 1973. (In German).

Scandpower was established in 1971 by a Norwegian industrial group as a consultant firm in the nuclear power field. Through its cooperation with Institutt for Atomenergi and Det Norske Veritas Scandpower has access to advanced methods and procedures in the fields of reactor safety, component and material technology, fuel technology and strategy, control and instrumentation and digital computer control. Scandpower has also a cooperation agreement with Burmot (Burns and Roe and Motor Columbus) which provides a source of expertise in power plant technology. How this background can be utilized in the developing nuclear power market in Norway and the other Nordic countries is then described. (NO)

23729 NUCLEAR ENERGY IN THE FEDERAL REPUBLIC OF GERMANY. Winnacker, K. At. Inform.; No. 1, 4-7(1973). (In German).

The situation of nuclear energy is discussed with respect to other primary energy sources (gas, oil, coal) in the light of historical and political implications. Due to complicated procedures in reactor licensing and the federal structure, reactor builders and operators are confronted with administrative problems. The extensive discussions on reactor safety and the trends to be observed in public opinion result in similar difficulties. The economic situation of the nuclear industry is discussed in connection with the fourth Atomic Programme of the Federal Republic of Germany. Finally, the role of the Atomic Forum as a partner in matters of public relations is discussed. (GE)

23730 NUCLEAR POWER PLANTS AND THEIR EFFECT ON ECONOMIC STRUCTURES. At. Inform.; No. 2, 12-13(1973). (In German).

The main results of various studies which relate to interactions of nuclear energy supply and economic structures within certain regions are compiled (initiated by the local government of the State of Northrhine-Westfalia and the German Federal Ministry for Research and Education). The main topics of these studies are: relation between cost and power output of units, employment structure, relation between energy supply, and the siting region, effects of standardization of fuel elements, containment, electric safety devices, etc. on economics. Finally, a survey is given of the expected imports of energy by the European Community which is compared with the figures for the prospected energy demand for the United States, as published by the Secretary of the Interior. (GE)

23731 METHOD FOR COMPARING DIFFERENT ASPECTS OF ATOMIC POWER STATIONS. Verkhivker, G. P. At. Energ. (USSR); 34: No. 4, 293-295(Apr 1973). (In Russian).

A number of expressions are discussed which relate fuel costs, capital investment, reactor efficiency, thermal power of the reactor, and similar parameters of a nuclear power station. (KSW)

23732 EVALUATION OF FUEL UTILIZATION CAPABILITY OF NUCLEAR REACTORS. Levai, A.; Csom, G. Energ. Atomtech.; 26: No. 1, 39-45(Jan 1973). (In Hungarian).

One of the basic determining characteristics of the economic evaluation of nuclear power stations is the capability of fuel utilization. Uranium consumption at the PWR and AGR reactors, which are considered as the most advanced, is analyzed. The comparison shows that the PW reactors and fast-breeder reactors have a fuel utilization greater than those of the other reactors. These systems now have maximum efficiency of 3 to 6 percent. (auth)

Reactor Fuel Cycle Economics

Refer also to abstracts 21438 and 23541.

23733 (IFA-FR-99-1973) BCV-5 CODE FOR EVALUATING THE FUEL NEEDS IN AN ENERGY SYSTEM GROUP WITH FAST AND THERMAL REACTORS. Boeriu, S.; Cepraga, D.; Vata, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 14p. (In Rumanian). Dep. NTIS (U. S. Sales Only) $3.00.

The structure of the BCV-5 code and input instructions are given, following discussions of the reactor types and fuel circulation considered, the net consumption of fissile material as a function of time, inventory components, and fissile material needs. The reactors considered include those fueled with natural uranium metal or enriched uranium oxide, high-temperature reactor, the PWR, BWR, HWR, FBR, and LFR. (TTT)

23734 PLUTONIUM: WASTE OR VALUABLE FUEL. Stoll, W. (Alpha Chemie und Metallurgie, GmbH, Hanau, Ger.). Umsch. Wiss. Tech.; 73: No. 9, 261-264(1973). (In German).

Following a brief introduction the differences in plutonium and uranium fuel as well as the feasibility of Pu recycling in light-water and high-temperature reactors are discussed. Some problems encountered in plutonium technology and present achievements in this field are also discussed. (GE)

Reactor Licensing and Regulation

Refer also to abstracts 23601, 23602, and 23729.

23735 (CEA-CONF-2291) COOPERATION IN THE NUCLEAR REACTOR DOMAIN. Point of View of Different Enterprises: The French Atomic Energy Commission. de Faria, P. (Commissariat a l'Energie Atomique, Paris (France)). 1973. 23p. (In French). (CONF-730341-4). Dep. NTIS (U. S. Sales Only) $3.25.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

The role of the CEA in international cooperations is recalled. Various bilateral agreements concluded between the CEA and similar foreign organizations are analyzed. (FR)

23736 (CONF-730341-5) DEVELOPMENTS MADE BY THE OECD AGENCY IN THE FIELD OF NUCLEAR ENERGY. Reyners, P. (European Nuclear Energy Agency, Paris (France)). 1973. 24p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

In the field of international cooperation in the domain of nuclear reactors, the OECD agency for nuclear energy is responsible for some direct cooperation initiatives (joint enterprises) as well as for certain indirect promotion activities (coordination groups) and for scientific and technical cooperation. (FR)

23737 (CONF-730341-11) INTERNATIONAL COOPERATION IN THE FIELD OF NUCLEAR REACTOR VIEWED BY EURATOM. Prelle, M. (European Communities, Brussels (Belgium). Commission). 24 Jan 1973. 13p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

The ambitions of the Euratom treaty in the domain of cooperation are recalled. The progress already made is discussed, the difficulties and limitations encountered by the Community in the economic, political, and legal spheres being evoked. (FR)

23738 (DOCKET-50003-186) INDIAN POINT STATION, UNITS 1 AND 2. Facility Operating License DPR-26, Appendix B, Environmental Technical Specifications Requirements. (Consolidated Edison Co. of New York, Inc., New York). 9 Aug 1973. 131p. (Docket-50247-122). Dep. NTIS $8.75.

23739 (DOCKET-50003-187) INDIAN POINT STATION, UNIT 1. Environmental Report and Benefit Cost Analysis, Supplement 1, June 1973. (Consolidated Edison Co. of New York, Inc., New York). 15 Aug 1973. 127p. Dep. NTIS $8.50.

23740 (DOCKET-50016-197) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Operations Report, February 1973. (Power Reactor Development Co., Detroit, Mich.). 15 Aug 1973. 13p. (EF-114). Dep. NTIS $3.00.

23741 (DOCKET-50016-198) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Operations Report, March 1973. (Power Reactor Development Co., Detroit, Mich.). 15 Aug 1973. 12p. (EF-115). Dep. NTIS $3.00.

23742 (DOCKET-50206-208) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Specific Comments on Draft Environmental Statement by the Directorate of Licensing. (Southern California Edison Co., Rosemead, Calif.). 25 Jul 1973. 10p. Dep. NTIS $3.00.

23743 (DOCKET-50213-210) CONNECTICUT YANKEE ATOMIC POWER PLANT. Comments on Draft Environmental Statement. (Connecticut Yankee Atomic Power Co., Hartford). 10 Aug 1973. 25p. Dep. NTIS $3.25.

23744 (DOCKET-50220-146) NINE MILE POINT NUCLEAR STATION, UNIT 1. Proposed Change to Existing Reactor Building Crane. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 26 Jul 1973. 20p. Dep. NTIS $3.00.

23745 (DOCKET-50245-229) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Inservice Inspection Report. (General Electric Co., Philadelphia, PA). 1972. 89p. Dep. NTIS $6.50.

For Millstone Point Co., Hartford, CT.

Results of the first inservice inspection performed during the first refueling outage are reported. The inspection was performed to meet the requirements of the ASME Boiler and Pressure Vessel Code Section XI and the Technical Specifications Section F. Welds and components were inspected using ultrasonic, liquid dye penetrant, and visual testing procedures. Five pipe welds, two integrally welded supports, and one non-integrally welded support were found to be unsatisfactory, and indications of cracking on two valve disk seating surfaces were reported. (FS)

23746 (DOCKET-50247-123) INDIAN POINT NUCLEAR GENERATING UNIT 2. Technical Specifications, Change 2, Dated August 9, 1973. (Consolidated Edison Co. of New York, Inc., New York). 1973. 98p. Dep. NTIS $7.00.

Corrections and additional information are presented for inclusion in the Technical Specifications. (FS)

23747 (DOCKET-50261-197) H. B. ROBINSON UNIT 2. Semiannual Operating Report No. 6, January 1–June 30, 1973. (Carolina Power and Light Co., Raleigh, N. C.). 29 Aug 1973. 245p. Dep. NTIS $14.25.

23748 (DOCKET-50263-222) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Summary Technical Report on Secondary Containment Leak Rate Test. (Northern States Power Co., Minneapolis, Minn.). 23 Jul 1973. 10p. Dep. NTIS $3.00.

23749 (DOCKET-50263-223) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Summary Technical Report on Primary Containment Integrated Leakage Rate Test. (Northern States Power Co., Minneapolis, Minn.). 3 Aug 1973. 50p. Dep. NTIS $4.50.

23750 (DOCKET-50263-224) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Lapse of Off-Gas Stack Monitoring Due to Switch in Purge Position. (Northern States Power Co., Minneapolis, Minn.). 17 Aug 1973. 2p. Dep. NTIS $3.00.

23751 (DOCKET-50267-68) FORT ST. VRAIN NUCLEAR GENERATING STATION. Progress Report, Ecological Inventory. (Thorne Ecological Inst., Boulder, Colo. (USA)). 1 Nov 1972. 213p. Dep. NTIS $12.75.

For Public Service Co. of Colorado, Denver.

Fishes, aquatic invertebrates, fish food, artificial substrates, algae, aquatic insects, avian populations, soil characteristics, taxonomic inventory of flowering plants, inventories of vegetation, mammals, amphibians, and terrestrial invertebrates were investigated. Literature reviews on Nuclear Reactor Radionuclides in Forages and Plants of Terrestrial Ecosystems, Mercury in Terrestrial Ecosystems, Cadmium in Terrestrial Ecosystems, Lead in Soils and Plants, and Plant Uptake of Lead and Distribution: With Reference to Biological Accumulation and Magnification in Terrestrial Ecosystems are also included. (FS)

23752 (DOCKET-50269-120) OCONEE NUCLEAR STATION, UNIT 1. Operational Quality Assurance Program, Supplementary Information. (Duke Power Co., Charlotte, N. C.). 31 Jul 1973. 33p. Dep. NTIS $3.75.

23753 (DOCKET-50269-121) OCONEE NUCLEAR STATION, UNIT 1. RO Inspection Report No. 73-8. (Duke Power Co., Charlotte, N. C.). 1 Aug 1973. 21p. Dep. NTIS $3.25.

23754 (DOCKET-50269-122) OCONEE NUCLEAR STATION, UNIT 1. Semiannual Operating Report, Period Ending June 30, 1973. (Duke Power Co., Charlotte, N. C.). 28 Aug 1973. 398p. Dep. NTIS $22.00.

23755 (DOCKET-50270-96) OCONEE NUCLEAR STATION, UNITS 2 AND 3. Safety Evaluation Report, Supplement 1. (Duke Power Co., Charlotte, N. C.). 2 Aug 1973. 26p. (Docket-50287-86). Dep. NTIS $3.50.

The effects of fuel densification in normal operation, operation during transient conditions, and postulated accident conditions show that the Oconee-2 reactor can be operated safely up to 100% of rated power with no undue risk to the health and safety of the public. (FS)

23756 (DOCKET-50280-147) SURRY POWER STATION, UNITS 1 AND 2. Proposed Technical Specification, Change 11. (Virginia Electric and Power Co., Richmond). 17 Jul 1973. 5p. (Docket-50281-117). Dep. NTIS $3.00.

Specification changes concerning deletion of power limitations and pressures for containment leak rate testing are proposed. (FS)

23757 (DOCKET-50280-148) SURRY POWER STATION, UNITS 1 AND 2. Topical Report on GE Vertical Induction Motors Inside Containment Recirculation Spray Pump Motors. (General Electric Co., San Jose, Calif.). 12 Jun 1973. 119p. (DOCKET-50281-118). Dep. NTIS $8.00.

For Virginia Electric and Power Co., Richmond.

Tests on the replacement vertical induction motor, which is totally enclosed and fan cooled, indicate that the motor functions adequately in the containment environment following a design basis loss of coolant accident, and also meets the technical specifications. (FS)

23758 (DOCKET-50280-150) SURRY POWER STATION, UNITS 1 AND 2. Abnormal Occurrence No. AO-S1-73-08: High Level Intake Canal-Low Level Circulating Water-High Temperature. (Virginia Electric and Power Co., Richmond). 19 Jul 1973. 7p. (DOCKET-50281-119). Dep. NTIS $3.00.

23759 (DOCKET-50282-127) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Pipe Rupture Analyses of Main Steam Piping Outside Containment. (Nuclear Services Corp., Campbell, Calif. (USA)). 12 Jun 1973. 135p. Dep. NTIS $8.75.

23760 (DOCKET-50282-128) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Pipe Rupture Analyses of Feedwater Piping Outside Containment. (Nuclear Services Corp., Campbell, Calif. (USA)). 12 Jun 1973. 198p. Dep. NTIS $12.00.

23761 (DOCKET-50282-131) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Facility Operating License, DPR-42, Appendix A and Appendix B. (Northern States Power Co., Minneapolis, Minn.). 9 Aug 1973. 276p. (Docket-50306-119). Dep. NTIS $16.00.

Appendices A and B to the facility operating license are presented. Appendix A consists of the technical specifications concerning safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls. Appendix B, the environmental technical specifications and bases, includes the protection conditions, monitoring requirements, environmental surveillance and special studies, and administrative reporting requirements. (FS)

23762 (DOCKET-50285-101) FORT CALHOUN STATION, UNIT 1. Facility Operating License No. DPR-40, Amendment 1 and Technical Specifications, Appendix A and Appendix B. (Omaha Public Power District, Nebr.). 8 Aug 1973. 243p. Dep. NTIS $14.25.

Authorization for steady state operation at core power levels not to exceed 1420 MW(t) is granted and Appendices A and B technical specifications are appended to the operating license. The technical specifications cover safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, administrative controls, and iterim special technical specifications on the effects of fuel densification and operation at power levels above 10^{-1}% of the rated power on four reactor coolant pumps. The technical environmental specifications are concerned with the condenser cooling water temperature, chemical discharge limits, the monitoring and surveillance program, study and evaluation programs, and reporting requirements. (FS)

23763 (DOCKET-50295-140) ZION STATION NUCLEAR POWER PLANT, UNIV 1. Report on Structural Integrity Test, March 26, 1973. (Commonwealth Edison Co., Chicago, Ill.). 23 Jul 1973. 41p. Dep. NTIS $4.25.

23764 (DOCKET-50302-83) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Final Safety Analysis Report, Amendment 29. (Florida Power Corp., St. Petersburg). 8 Aug 1973. 349p. Dep. NTIS $19.50.

Responses to requests for additional information concerning the reactor, reactor control system, engineered safety features, instrumentation and controls, electric power, auxiliary systems, steam and power conversion, radioactive waste management, radiation protection, conduct of operations, initial tests and operation, and accident analysis are presented. (FS)

23765 (DOCKET-50327-40) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Environmental Radioactivity Levels, Semiannual Report, February–July 1972. (Tennessee Valley Authority, Chattanooga. Div. of Environmental Research and Development). 11 Jul 1973. 42p. (DOCKET-50328-38). Dep. NTIS $4.25.

Radioactivity in the air, rain, deposited fallout, charcoal filters, milk, vegetation, soil, well water, public water, poultry, food crops, river water, fish, plankton, clams, and sediments was monitored and is reported. Since fuel has not yet been delivered to the plant, there was no contribution of radioactivity to the environment. All activity levels are due to background radiation, nuclear weapon testing, or other nuclear operations in the area. (FS)

23766 (DOCKET-50331-102) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 13-A. (Iowa Electric Light and Power Co., Cedar Rapids). 3 Aug 1973. 246p. Dep. NTIS $14.50.

Revised pages for the license application, FSAR, Preparedness Plan, and the Industrial Security Plan are presented on site characteristics, the reactor, engineered safety systems, instrumentation and control, electric power, steam and power conversion, conduct of operations, and initial tests and operation. (FS)

23767 (DOCKET-50335-66) ST. LUCIE PLANT, UNIT 1. Final Safety Analysis Report, Amendment 14. (Florida Power and Light Co.). 3 Aug 1973. 178p. Dep. NTIS $11.00.

Responses are provided for AEC questions on site characteristics, radioactive waste management, radiation protection, conduct of operations, technical specifications, and quality assurance. (FS)

23768 (DOCKET-50341-62) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Applicant's Responses to AEC Letter Dated July 9, 1973 with 17 Questions Regarding RHR Service Water Pond Design. (Detroit Edison Co., Mich.). 10 Aug 1973. 76p. Dep. NTIS $6.00.

23769 (DOCKET-50344-67) TROJAN NUCLEAR PLANT. Annual Report on the Meteorological Program, September 1, 1971–August 31, 1972. (Nus Corp., Rockville, Md. (USA). Environmental Safeguards Div.). Jul 1973. 238p. (Nus-1002). Dep. NTIS $14.00.

A summary and analysis of weather at the Trojan Plant site for the period September 1971 through August 1972 are presented. (FS)

23770 (DOCKET-50352-41) LIMERICK GENERATING STATION, UNITS 1 AND 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Aug 1973. 554p. (Docket-50353-41). Dep. NTIS $29.75.

The environmental effects of construction and operation of the Limerick Generating Station, Units 1 and 2, are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

23771 (DOCKET-50354-44) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Impact Statement Comments, June 1973. (Public Service Electric and Gas Co., Newark, N. J.). 22 Jun 1973. 24p. (DOCKET-50355-44). Dep. $3.25.

23772 (DOCKET-50387-42) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. License Application, PSAR, Amendment 11. (Pennsylvania Power and Light Co., Allentown). 26 Jul 1973. 3p. (Docket-50388-41). Dep. NTIS $3.00.

Revised completion dates are proposed. (FS)

23773 (DOCKET-50404-53) NORTH ANNA POWER STATION, UNITS 3 AND 4. Report, Supplemental Geologic Data. (Dames and Moore, Cranford, N. J. (USA)). 17 Aug 1973. 158p. (DOCKET-50405-52). Dep. NTIS $10.00.

For Virginia Electric and Power Co., Richmond.

Descriptive information is provided concerning an inactive fault which is very old and presents no problems for the reactor site. The exposed shear zone is a minor feature associated with metamorphism and ductile rock conditions which indicate that the fault originated during a time of deep burial and high rock temperatures. (FS)

23774 (DOCKET-50409-58) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for April 1973. (Dairyland Power Cooperative, La Crosse, Wis.). 1973. Contract AT(11-1)-851. 32p. (DPC-851-59). Dep. NTIS $3.75.

23775 (DOCKET-50409-59) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for May 1973. (Dairyland Power Cooperative, (La Crosse, Wis). 1973. Contract AT(11-1)-851. 31p. (DPC-851-60). Dep. NTIS $3.75.

23776 (DOCKET-50412-26) BEAVER VALLEY POWER STATION, UNIT 2. License Application, Amendment 1, Additional Financial Information. (Duquesne Light Co., Pittsburgh, PA). 30 Jul 1973. 326p. Dep. NTIS $18.50.

23777 (DOCKET-50413-36) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Questions and Answers on Cooling Towers. (Duke Power Co., Charlotte, N. C.). 3 Aug 1973. 48p. (Docket-50414-36) Dep. NTIS $4.50.

23778 (DOCKET-50423-23) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Comments on Draft Environmental Statement. (Millstone Point Co., Hartford, Conn.). 10 Aug 1973. 22p. Dep. NTIS $3.25.

23779 (DOCKET-50424-22) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 6. (Georgia Power Co., Atlanta). 7 Aug 1973. 303p. (Docket-50425-22; Docket-50426-22; Docket-50427-22). Dep. NTIS $17.25.

Responses to AEC questions concerning site characteristics, design criteria, engineered safety features, auxiliary systems, steam and power conversion, radioactive waste management, and accident analysis are provided. (FS)

23780 (DOCKET-50438-12) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 2. (Tennessee Valley Authority, Chattanooga). 30 Jul 1973. 101p. (Docket-50439-12). Dep. NTIS $7.25.

Miscellaneous revisions and responses to AEC questions on site characteristics, design criteria, the reactor control system, engineered safety features, and auxiliary systems are presented. (FS)

23781 (DOCKET-50440-18) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 2. (Cleveland Electric Illuminating Co., Ohio). 8 Aug 1973. 35p. (Docket-50441-18). Dep. NTIS $3.75.

Responses to AEC questions concerning the effect of shale heave on the emergency service water pump house and the gas explosion potential are made. (FS)

23782 (DOCKET-50443-12) SEABROOK STATION, UNITS 1 AND 2. License Application, PSAR, Amendment 1. (Public Service Co. of New Hampshire, Manchester). Jul 1973. 131p. (Docket-50444-12) Dep. NTIS $8.75.

Revised and supplementary data concerning site characteristics, design criteria, engineered safety features, radiation protection, and accident analysis are presented. (FS)

23783 (DOCKET-50443-13) SEABROOK STATION, UNITS 1 AND 2. License Application, Volume 1, Supplemental Information. (Public Service Co. of New Hampshire, Manchester). 3 Aug 1973. 154p. (Docket-50444-13). Dep. NTIS $9.75.

23784 (DOCKET-50445-2) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 1. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 267p. (DOCKET-50446-2). Dep. NTIS $15.50.

The plant description and identification of agents and contractors are given. The geography, meteorology, and industrial, transportation, and military facilities near the reactor site are described. (FS)

23785 (DOCKET-50445-3) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 2. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 344p. (DOCKET-50446-3). Dep. NTIS $19.25.

Site characteristics concerning hydrologic engineering, geology and seismology, foundation investigations, and a summary of the site investigations and laboratory tests are presented. (FS)

23786 (DOCKET-50445-4) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Re-

port, Volume 3. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 298p. (DOCKET-50446-4). Dep. NTIS $17.00.

Design criteria concerning structures, components, and systems including wind and tornado loadings, water level, missile protection, seismic design, protection against dynamic effects associated with a postulated pipe rupture, category 1 structures, mechanical systems and components, seismic design of category 1 instruments and electrical equipment and environmental design of mechanical and electrical equipment are presented. (FS)

23787 (DOCKET-50445-5) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 4. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 416p. (DOCKET-50446-5). Dep. NTIS $23.00.

The description, and the mechanical, nuclear, and thermal design of the two PWR reactors; the reactor coolant system and connected systems; engineered safety features; instrumentation and controls; and onsite, offsite, and auxiliary electric power systems are presented. (FS)

23788 (DOCKET-50445-7) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 6. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 380p. (DOCKET-50446-7). Dep. NTIS $21.00.

Radiation protection including shielding, ventilation, and the health physics program; conduct of operations including organizational structure, training, emergency planning, audit and review, plant records, and industrial security; initial tests and operation; accident analysis; technical specifications; and quality assurance during design and operation are presented. (FS)

23789 (DOCKET-50445-8) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Information Requested by the Attorney General for Antitrust Review. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 69p. (DOCKET-50446-8). Dep. NTIS $5.50.

23790 (DOCKET-50445-9) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Information Requested by the Attorney General for Antitrust Review, Appendix A, Volume 1. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 202p. (DOCKET-50446-9). Dep. NTIS $12.25.

23791 (DOCKET-50445-10) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Information Requested by the Attorney General for Antitrust Review, Appendix A, Volume 2. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 218p. (DOCKET-50446-10). Dep. NTIS $13.00.

23792 (DOCKET-50445-11) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Information Requested by the Attorney General for Antitrust Review, Appendix A, Volume 3. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 233p. (DOCKET-50446-11). Dep. NTIS $13.75.

23793 (DOCKET-50445-12) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Environmental Report, Volume 1. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 399p. (DOCKET-50446-12). Dep. NTIS $22.00.

The environmental effects of construction and operation of the Comanche Peak-1 and -2 reactors are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits–cost analysis of the proposed plant operation. (FS)

23794 (DOCKET-50445-13) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Environmental Report, Volume 2. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 473p. (DOCKET-50446-13). Dep. NTIS $25.75.

23795 (DOCKET-50445-14) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Environmental Report, Volume 3. (Texas Utilities Generating Co., Dallas (USA)). 18 Jul 1973. 509p. (DOCKET-50446-14). Dep. NTIS $27.50.

23796 (DOCKET-50445-15) COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 1. (Texas Utilities Generating Co., Dallas (USA)). 31 Jul 1973. 669p. (DOCKET-50446-15). Dep. NTIS $35.50.

Changes concerning the plant description, site characteristics, design criteria, engineered safety features, auxiliary systems, steam and power conversion, radioactive waste management, radiation protection, conduct of operations, accident analysis, technical specifications and quality assurance are presented. AEC questions on the plant description, site characteristics design criteria, the reactor, engineered safety systems, auxiliary systems, steam and power conversion, radioactive waste management, radiation protection, conduct of operations, accident analysis and quality assurance are answered. (FS)

23797 (DOCKET-50448-1) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 1. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 502p. (DOCKET-50449-1). Dep. NTIS $27.25.

The nuclear plant is described and the agents and contractors are listed. The geography, meteorology, and hydrology concerning the plant site are presented and nearby industrial, transportation, and military facilities are described. (FS)

23798 (DOCKET-50448-2) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 2. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 390p. (DOCKET-50449-2). Dep. NTIS $21.50.

Geology and seismology basic information, vibratory ground motion, surface faulting, stability and subsurface materials, and slope stability are presented to complete the site characteristics. (FS)

23799 (DOCKET-50448-3) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 3. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 456p. (DOCKET-50449-3). Dep. NTIS $25.00.

Design criteria including wind and tornado design flood water level design, missile protection, seismic qualifications, Category I structures, mechanical systems and components, Category I instrumentation and electrical equipment, environmental design of mechanical and electrical systems, and protection against dynamic effects associated with postulated pipe ruptures, are presented for structures, components, and systems. (FS)

23800 (DOCKET-50448-4) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 4. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 467p. (DOCKET-50449-4). Dep. NTIS $25.55.

Information is presented on the BWR type reactors and the reactor coolant systems and connected systems. (FS)

23801 (DOCKET-50448-5) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 5. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 292p. (DOCKET-50449-5). Dep. NTIS $16.80.

The engineered safety features of the containment, ECCS, ECCS area exhaust system, and the habitability systems are presented. (FS)

23802 (DOCKET-50448-6) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 6. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 482p. (DOCKET-50449-6). Dep. NTIS $26.30.

Instrumentation and control systems concerning the engineered safety features, trip systems, systems required for safe shutdown and safety related display systems are presented. (FS)

23803 (DOCKET-50448-7) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 7. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 532p. (DOCKET-50449-7). Dep. NTIS $28.80.

Instrumentation and controls for refueling interlocks, process radiation monitoring, reactor water cleanup system, leak detection, neutron monitoring, and the process computers are described. Onsite and offsite electric power and the following auxiliary systems, fuel storage and handling, compressed air, sampling, floor drainage, air conditioning, ventilation, heating, cooling, fire protection, communications, lighting, and the diesel generator fuel oil storage and transfer systems, are presented. (FS)

23804 (DOCKET-50448-8) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 8. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 456p. (DOCKET-50449-8). Dep. NTIS $25.00.

The turbine-generator, main steam supply system, main condenser, circulating water system, condensate cleanup sys-

tem, and the feedwater system are described. Shielding, ventilation, the health physics program and solid, liquid, and gaseous radioactive waste programs are explained. The organization, training, emergency planning, reviews, audits, procedures, records, and industrial security plans are presented. (FS)

23805 (DOCKET-50448-9) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 9. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973 462p. (DOCKET-50449-9). Dep. NTIS $25.30.

Information is presented concerning accident analysis; technical specifications, including safety limits and limiting safety system settings, limiting conditions for operation and surveillance requirements, major design features, and administrative controls; and the quality control program during design and construction. (FS)

23806 (DOCKET-50448-10) DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 10. (Potomac Electric Power Co., Washington, D. C. (USA)). 8 Aug 1973. 425p. (DOCKET-50449-10). Dep. NTIS $23.45.

Appendices with information concerning definitions, plant nuclear safety, operational analysis, site foundation studies, and the probability of an aircraft from Quantico colliding with the station are presented. (FS)

23807 (DOCKET-50450-1) SUMMIT POWER STATION, UNITS 1 AND 2. Information Requested by the Attorney General for Antitrust Review. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 12 Jun 1973. 129p. (DOCKET-50451-1). Dep. NTIS $8.50.

23808 (DOCKET-50450-3) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 1. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 864p. (Docket-50451-3). Dep. NTIS $45.25.

Information concerning the plant description, contractors, the geography, meteorology, hydrology, geology, and seismology of the plant site and nearby industrial, transportation, and military facilities is presented. (FS)

23809 (DOCKET-50450-4) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 2. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 557p. (DOCKET-50451-4). Dep. NTIS $30.00.

Design criteria of structures, components, and systems, and the reactor design are presented. (FS)

23810 (DOCKET-50450-5) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 3. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 452p. (DOCKET-50451-5). Dep. NTIS $24.75.

Data concerning the reactor coolant system and connected systems, and effluent and environmental measurements and monitoring programs are presented. (FS)

23811 (DOCKET-50450-6) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 4. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 430p. (DOCKET-50451-6). Dep. NTIS $23.50.

Data concerning the design of instrumentation and controls, and the offsite and onsite power systems are presented. (FS)

23812 (DOCKET-50450-7) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 5. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 576p. (DOCKET-50451-7). Dep. NTIS $31.00.

Data are presented concerning the auxiliary systems including fuel storage and handling, water systems, process auxiliaries including helium purification and storage, radioactive gas recovery, primary coolant monitoring, service air, and the liquid nitrogen system. Steam and power conversion and radioactive waste management are also described. (FS)

23813 (DOCKET-50450-8) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 6. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 425p. (DOCKET-50451-8). Dep. NTIS $23.25.

Information is presented concerning radiation protection including shielding, ventilation, and the health physics program; conduct of operations; initial tests and operation; and accident analysis which includes events leading to radioactivity, fission product, and tritium release to the environment, and methods to evaluate containment response to a PCRV penetration. (FS)

23814 (DOCKET-50450-9) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 7. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 27 Jun 1973. 384p. (DOCKET- 50451-9). Dep. NTIS $21.25.

The technical specifications, quality assurance program, and the appendices, which include information on conformance with AEC guides, additional site information, maximum hypothetical fission product release for site evaluation, PCRV development program, R and D programs related to plant design and supplementary reactor materials and chemistry data are presented. (FS)

23815 (DOCKET-50450-10) SUMMIT POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 1. (Delmarva Power and Light Co., Wilmington, Del. (USA)). Jul 1973. 275p. (DOCKET-50451-10). Dep. NTIS $15.75.

Changes concerning the plant description, site characteristics, design criteria, the reactor, reactor cooling systems, engineered safety features, electric power, auxiliary systems, radioactive waste management, technical specifications, and quality assurance are presented. (FS)

23816 (DOCKET-50450-11) SUMMIT POWER STATION, UNITS 1 AND 2. Environmental Report, Volume 1. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 15 Aug 1973. 736p. (DOCKET-50451-11). Dep. NTIS $39.00.

The environmental effects of construction and operation of the Summit-1 and -2 Reactors are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

23817 (DOCKET-50450-12) SUMMIT POWER STATION, UNITS 1 AND 2. Environmental Report, Volume 2. (Delmarva Power and Light Co., Wilmington, Del. (USA)). 15 Aug 1973. 809p. (DOCKET-50451-12). Dep. NTIS $42.50.

23818 (DOCKET-50450-13) SUMMIT POWER STATION, UNITS 1 AND 2. Environmental Report: Site Selection Report, Volume 1. (Delmarva Power and Light Co., Wilmington, Del. (USA)). Aug 1972. 539p. (DOCKET-50451-13). Dep. NTIS $29.00.

Potential areas for use as nuclear plant sites are compared and evaluated. The principal areas considered were Red Lion Creek, Odessa, and the Chesapeake and Delaware canal in Delaware and Claiborne and Denton, Maryland. Secondary sites considered include Bowers and Indian River in Delaware, and Corsica Neck–Spaniards Neck, Vienna, and Pocomoke City in Maryland. Recommendations, locations and descriptions, identification of environmental effects, licensing considerations, and economic comparisons are given for each site investigated. Appendices include biological, ecological, and engineering studies about the sites. (FS)

23819 (DOCKET-50450-14) SUMMIT POWER STATION, UNITS 1 AND 2. Environmental Report: Site Selection Report, Volume 2. (Delmarva Power and Light Co., Wilmington, Del. (USA)). Aug 1972. 244p. (DOCKET-50451-14). Dep. NTIS $14.25.

Geotechnical and environmental information, relevant to nuclear power plant siting at Red Lion, Odessa, the Chesapeake and Delaware Canal, Bowers, and Indian River in Delaware and Claiborne, Denton, Vienna, and Corsica Neck in Maryland are presented. Information is analyzed and evaluated for these sites concerning geology, foundation conditions, seismology, hydrology, surface and ground water and terrestrial ecology. (FS)

23820 (DOCKET-50450-15) SUMMIT POWER STATION, UNITS 1 AND 2. Environmental Report, Supplement. (Delmarva Power and Light Co., Wilmington, Del. (USA)). Jul 1973. 693p. (DOCKET-50451-15). Dep. NTIS $36.75.

23821 (DOCKET-STN-50437-8) OFFSHORE POWER SYSTEMS. License Application, Plant Design Reports, Amendment 1. (Offshore Power Systems, Jacksonville, Fla. (USA)). 10 Aug 1973. 137p. Dep. NTIS $9.00.

Revisions and responses to AEC comments concerning the plant site interfaces, design criteria, auxiliary systems, accident analysis, and the quality assurance program are provided. (FS)

23822 (DOCKET-STN-50447-3) GENERAL ELECTRIC STANDARD SAFETY ANALYSIS REPORT. Amendment 1. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 8 Aug 1973. 162p. Dep. NTIS $10.25.

Responses are provided for AEC questions on the plant description, design criteria, reactor design, reactor control system,

engineered safety features, auxiliary systems, radioactive waste management, radiation protection, and the quality assurance program. (FS)

23823 (DOCKET-STN-50447-9) GENERAL ELECTRIC STANDARD SAFETY ANALYSIS REPORT. License Application, Amendment 2. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). 17 Aug 1973. 193p. Dep. NTIS $11.75.

Responses to AEC questions on structural design, design criteria, radioactive waste management and radiation protection are provided. (FS)

23824 (FIND-50289-R2) FIND: THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Raleigh, H. D. (ed.). (Technical Information Center (AEC), Oak Ridge, Tenn.). Aug 1973. 28p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

23825 (FRNC-CONF-81) GENERAL EVOLUTION OF INTERNATIONAL COOPERATION POLITICAL AND LEGAL ASPECTS. Colliard, C. A. (Paris Univ. (France)). Dep. NTIS (U. S. Sales Only) $3.25.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

International aspects of the peaceful uses of atomic energy are examined together with the principal institutions involved in the cooperation (IAEA, CERN, Joint Institute for Nuclear Research, OECD and Euratom). (FR)

23826 (FRNC-CONF-84) COOPERATION IN THE NUCLEAR REACTOR DOMAIN. Point of View of Different Enterprises: French Electricity Board. Blaquiere, J. P. (Electricite de France, Paris). 1973. 15p. (In French). (CONF-730341-9). Dep. NITS (U. S. Sales Only) $3.00.

From international cooperation in reactor material and nuclear fuels conference; Paris, France (2 Mar 1973).

Franco-Belgian and Franco-Spanish Cooperation in the field of nuclear reactors is already a reality. Franco-Swiss cooperation is also well under way. In the future, in addition to certain foreign participation in the construction of French power plants, cooperation is envisaged in the field of advanced reactors (high temperature reactors and breeder reactors). (FR)

23827 (IDO-16981(Add.)) PRELIMINARY SAFETY ANALYSIS REPORT ADDENDUM, LOFT FACILITY. Bentzen, F. L.; Dietz, K. A.; Finnegan, L. J. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). 5 Nov 1964. 170p. Dep. NTIS $10.50.

Additional information for the LOFT Reactor PSAR is presented concerning design modifications, analysis of reactor operation using Zircaloy 4 cladding, engineering safety analysis of the loss-of-coolant test, radiological analysis of the loss-of-coolant test, and safety analysis of the maximum credible accident. (DCC)

23828 (RAI-73-7) REGULATORY ADJUDICATION ISSUANCES, JULY 1973. (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 Aug 1973. 90p. Dep. NTIS. TIC $1.25.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Board, and the Atomic Safety and Licensing Board are presented. (FS)

23829 (RDT-STATUS-7-73) BIMONTHLY STATUS REPORT: RDT Standards. Summary as of July 31, 1973. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 20 Aug 1973. 46p. RSO.

23830 (SGAE-2114) LICENSING PROCEDURE OF NUCLEAR POWER PLANTS IN FRANCE. Kamelander, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf. Institut fuer Reaktortechnik). Apr 1973. 22p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

23831 LICENSING AND REGULATORY CONTROL OF THERMAL POWER REACTORS IN THE UNITED KINGDOM. Gronow, W. S.; Gausden, R. (Dept. of Trade and Industry, London). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

The main safeguard to the public from any risks arising from nuclear plants has been and will continue to be the achievement of very high standards of design, construction and operation of those plants. In the United Kingdom, the operators of nuclear installations have to comply with legally binding conditions considered necessary by the responsible Minister, advised by his Nuclear Inspectorate who carry out rigorous checks on the safety of the design, construction and operation of all commercial nuclear power plants to ensure that the highest safety standards are attained. The regulatory controls and procedures adopted to enforce the safety provisions of the Nuclear Installations Acts are described. The experience gained in applying these controls to nuclear power plants is commented on. An outline of the organization of Nuclear Inspectorate and the arrangements made for the safe operation of nuclear plants is given. Some observations on urban siting and the criteria used for site selection in the UK are presented. (GE)

GENERAL

Energy Utilization and Economics

23832 (JUL-938-TP) ENERGY TRANSMISSION BY MEANS OF CRYOCABLES. Birnbreier, H.; Duering, K.; Fischer, W.; Heller, L.; Hofmann, A.; Komarek, P.; Kuhn, E.; Luecking, H. W.; Rasquin, W.; Zimmermann, E. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Mar 1973. 251p. (In German). Dep. NTIS (U. S. Sales Only) $14.75.

Six kinds of electrical insulations, three variations of the flow of the cooling medium, too possibilities for the arrangement of electrical and thermal insulation, and some kinds of conductor constructions are discussed. The justification of the use of a cryocable depends on the construction of the cable, on the materials that are used, and on the cooling machinery. For economic reasons, aluminum or copper will be the preferred material for the conductors. The cooling liquid can only be liquid nitrogen. The costs take into account the capital cost of the cable, termination and fitting costs, including installation, civil engineering, cooling stations, and costs of power losses, i.e., the costs for the electrical losses in the cable and the energy costs for the cooling stations. Advantages for the justification of the development of cryocables are that the width of the cable trench related to the power rating is considerably less when compared with conventional cables; by stepwise uprating of the installed cooling stations, the transmission capability can be adapted to the growing demand; a multiplication of the transmission capability is possible if more cooling stations are installed along the line; and even operating at the maximum continuous load, a cryocable can sustain a substantially higher short-time overload compared to a conventional cable because of its high heat capacity. (MCW)

23833 (ORNL-EIS-73-52(Vol.1)(No.7)) NSF–RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (Ed.). (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $3.75.

The bibliography contains abstracts of 114 publications on energy and includes energy sources; electric power (generation, supply and demand, transmission, environmental effects, and use); and energy (production, consumption, supply and demand, and policy). The research publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, progress reports, symposium papers and proceedings, monographs, and books published within the past two years. A list of energy research programs sponsored by the National Science Foundation–Research Applied to National Needs Program is included. (MCW)

23834 (ORNL-NSF-73-52(Vol.1)(No. 8)) NSF–RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (Ed.). (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

Abstracts of 94 items are presented, with availability of each item included. (MCW)

23835 UNIVERSAL SOLAR KITCHEN. Swet, C. J. (John Hopkins Univ., Baltimore). pp 720-726 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The widespread domestic use of solar energy would significantly reduce air pollution and conserve vital resources, especially in populous developing regions where many families burn foraged firewood, vegetable waste, or dung. However, currently available solar cookers, ovens, and water heaters have failed to gain general acceptance where they are needed most, mainly because of their limited utility and poor compatibility with traditional life styles. It now appears possible to produce at reasonable cost a "universal solar kitchen" that can satisfy most of the usual domestic requirements for thermal energy. The basic design is adaptable to a wide variety of ethnic and regional domestic practices, is readily transportable, and requires no special skills for installation or use. A conceptual approach to the design of universal solar kitchens is presented, with non-rigorous indications of feasibility, performance, producibility, and cost. Two possible embodiments emphasize the collection of the solar energy and its delivery to a convenient point of use or storage. (auth)

23836 AUTOMATIC GENERATOR FOR PRODUCTION OF PURE HYDROGEN FROM METHANOL. Dixon, A. G.; Houston, A. C.; Johnson, J. K. (Shell Research Ltd., Chester, Eng.). pp 1084-1090 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

A fully automated unit was developed for the production of 4.25 m^3/h (150 scfh) pure hydrogen by the catalytic steam reforming of methanol. Pure hydrogen was separated in a palladium/silver diffusion cell that was suspended integrally with the catalytic reactors in an externally heated fluidized bed with sand as a heat-transfer medium. The fluidized bed was heated by methanol combustion on startup and by combustion of the bleed gas from the diffusion cell after the operating-bed temperature (330°C) and pressure 18 to 20 bar (246 to 275 psig) were reached. Gross thermal efficiencies of 70 to 80% were observed at the rated output. The unit required no external services apart from a 22 to 30 V dc power supply for auxiliaries and control circuits. Power consumption under steady running condition was normally less than 130 W. Full-rated output was achieved in about 25 to 25 min from cold. Feed rate of aqueous methanol was automatically controlled by varying the pump speed as a combined function of temperature and pressure. Hydrogen storage allowed instantaneous step changes in demand to be met. (auth)

23837 ENERGY PLANTATION. Szego, G. C.; Fox, J. A.; Eaton, D. R. pp 1131-1134 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The solar energy falling on the Earth is far in excess of the rates of usage of energy from all sources. The main problems with solar energy are intermittency and low density. The use of photosynthesis on a planned operational scale seems to solve these problems in a cost-effective fashion, indeed highly competitive with coal, and at the same time does not require inordinate land areas. Technical and economic scenarios and analyses that compare the cost of a million Btu delivered with that for fossil fuels and nuclear energy sources are presented. (auth)

23838 ENERGY IN THE 1970'S: A SECOND LOOK. Weinhold, J. F. (Office of Science and Tech., Washington, DC). pp 1190-1195 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Environmental concerns dominated the 1970 energy picture, then turned to the basic economics of energy supply and demand. The National Environmental Policy Act of 1969, with its requirement for environmental impact statements has provided a vehicle for questioning federal actions involving nuclear power plants, other electric power facilities, off-shore oil and gas leases, oil shale development, and other energy technologies. The partnership between government and industry was given high visibility in the President's energy message of June 4, 1972. Each of the three priorities—the liquid metal fast breeder reactor, high-Btu-coal gasification, and sulfur oxide control technologies—is being developed in partnership with industry. New starts were made on several other energy technologies in the FY 73 budget. Additional energy technologies are being considered by a Federal Council for Science and Technology Energy R&D Goals Committee. Industry is also moving to increase its energy R&D efforts through the newly incorporated Electric Power Research Institute and other industry groups. (MCW)

23839 UTILIZATION ANALYSIS OF ENERGY SYSTEMS. Part I. Fundamentals of Energy Utilization. Hamel, B. B.; Brown, H. L. (Drexel Univ., Philadelphia). pp 1196-1208 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Energy utilization is defined here as: (i) system utilization, that is a measure of system performance in supplying the demand factor of the energy system; (ii) energy productivity, that is a measure of the effectiveness of the demand sector of the system i.e., product or service output per unit energy input; and (iii) system constraints, that represent the conditions imposed by the larger energy system. System utilization is developed in detail. An analytical formulation of a general energy using system is developed, based upon the fundamental concept of thermodynamic availability. A general energy system is defined in terms of system elements—discrete energy users and converters. Utilization criteria and effectiveness parameters are defined in terms of

ideal performance of the system in which the reversible transfer of energy is considered ideal. From these criteria and performance parameters it is possible to determine the degree of mismatch between the quality of energy supplied and needed; the impact of cascading energy within the system; the effects of system components, with their associated coefficients and interconnection matrices, on the performance of the general energy using system; and the degree of departure of system performance from the ideal. (MCW)

23840 UTILIZATION ANALYSIS OF ENERGY SYSTEMS. Part II. Application of Utilization Criteria to House Energy System. Hamel, B. B.; Brown, H. L.; Crane, R. E.; Nwude, J. K. (Drexel Univ., Philadelphia). pp 1209-1222 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Energy utilization analysis and criteria are applied to the energy system of an all-electric and gas–electric house to demonstrate the feasibility of this analytical approach on a real system and to gain insight into the character of energy utilization in a house. Data show that the grade level of energy required is, on the average, low, generally being dominated by the low-grade requirements of the heating and hot-water systems. Profiles are developed to demonstrate that these energy requirements are met by having converters taking high-quality energy and producing low-grade hot water and hot air—thus, establishing a mismatch between supply and demand. Basically, two points are established about house energy-system utilization: Firstly, the requirement for low-grade thermal energy is met by taking high-quality energy from outside the system and passing it through low-performance converters. Secondly, the cascading of discharge energy improves system performance by increasing one effectiveness parameter from a value of 0.158 (without cascading) to 0.172 and improving a second from 5.64 to 5.5 relative to an ideal value of 0.393. (MCW)

23841 URBAN UTILIZATION OF EXTRACTED HEAT AND WASTE HEAT FROM CENTRAL STATION POWER PLANTS. Beall, S. E. Jr.; Miller, A. J. (Oak Ridge National Lab., TN). pp 1223-1229 of 7th Intersociety Energy Conversion Engineering Conference. Washington, American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

An analysis is presented of the feasibility of providing thermal energy as well as electricity to urban areas from central station steam-electric power plants. Consideration is given to the use of thermal energy for applications such as industrial processes, building space heating, air conditioning, sewage treatment, agriculture, and aquaculture. The use of dual-purpose plants significantly reduces the consumption of fuel and lessens the environmental impact of providing energy as compared to conventional systems. Areas of multifamily dwellings and other multistoried buildings could be served in new cities, or renewed old cities, at costs comparable to those incurred with more conventional separate systems. However, it would require more planning of facilities and coordination of diverse organizations than we normally employ. The costs and dislocations associated with retrofitting existing cities would cause each city to be a separate case. (auth)

23842 TECHNOLOGY AND ECONOMICS OF UTILITY TUNNELS AND COMMON TRENCHING. Boegly, W. J. Jr.; Griffith, W. L. (Oak Ridge National Lab., TN). pp 1230-1235 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

In urban areas expansion of underground utility systems and the possibility of installing additional utilities such as central heating and cooling, solid waste collection systems, and pneumatic mail delivery systems, will produce increased competition for the available installation space. Such competition is already a way of life for utility companies operating in the dense areas of our larger cities. Utility tunnels or the common installation of multiple utilities in the same trench may be a solution. A design study for a utility tunnel system in White Plains, New York is used to illustrate the application of this concept. Cost differences between conventional buried utilities and utilities installed in tunnels are also presented. Common or joint trenching presents many of the same problems as the utility tunnel. Safety and coordination problems have restricted its use in the past. Current practices and research into the deterrents to common trenching will be described, along with suggested practices and anticipated economic gains. (MCW)

23843 UTILIZATION ANALYSIS OF ENERGY SYSTEMS. Part III. Urban Energy System Manufacturing Industry Data Base and Energy Maps. Brown, H. L.; Hamel, B. B.; Hinkle, B. K.; Schleyer, W. T. (Drexel Univ., Philadelphia). pp 1236-1246 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The broad data requirements for analysis of an urban energy system are defined using the City of Philadelphia as an urban laboratory. The energy system is described and includes the type (electricity, gas, oil, coal, steam), amount, density, and grade or quality of energy required by the various economic sectors (manufacturing, residential, commercial, utilities, and transportation). The urban data base is established for the manufacturing industry sector in Philadelphia for the year 1969. Total energy and energy density maps for the manufacturing sector for electricity, gas, oil, and coal are presented with a breakdown of energy consumption by major industries. (MCW)

23844 MINIMIZATION OF RESIDENTIAL ENERGY CONSUMPTION. Harvey, D. G. (Hittman Associates Inc., Baltimore); Kudrick, J. A.; Leighton, G. pp 1247-1255 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The current fuel crisis and rapidly increasing fuel consumption throughout the country has highlighted the need to economize on their use. With this thought in mind, Hittman Associates, Inc. under HUD sponsorship has been studying various means by which energy consumption within single-family, townhouse, and multifamily residences can be reduced without changing the basic life style of the residence. Preliminary results are presented and several potential energy saving concepts are discussed. (auth)

23845 CRITICAL LOOK AT TOTAL ENERGY SYSTEMS AND EQUIPMENT. Gamze, M. G. (Gamze-Korobkin-Caloger, Inc., Chicago). pp 1263-1268 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The total energy concept, the history of the concept, and the problems involved in designing and installing TE systems are discussed. The basic problem is that such systems have to be custom designed around components that are not always totally suited for TE application. This necessitates extensive engineering to design a dependable installation and rigorous maintenance procedures to insure system reliability after the job has been placed in operation. A detailed listing of the problems of the TE concept is presented. This is followed by specific recommendations to improve upon existing hardware and to develop new hardware in order to make the TE concept a viable one that will permit its potential for conserving fossil fuels and reducing air, water, and thermal pollution to be realized. (auth)

23846 ECO-ENERGY. Hausz, W.; Leeth, G.; Meyer, C. (General Electric Co., Santa Barbara, CA). pp 1316-1322 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

To study our future national electrical energy needs and means of supplying them, a system analysis must give balanced attention to ecological, economic, and societal factors. A parametric analysis of post-1990 systems and transitional modes identified a promising candidate system: the use of efficient gas turbines or fuel cells, at distribution level, which burn pipeline-delivered hydrogen generated at large, remotely located energy centers. (auth)

23847 HYDROGEN–ELECTRIC UTILITY SYSTEM WITH PARTICULAR REFERENCE TO FUSION AS THE ENERGY SOURCE. Tanner, E. C. (Princeton Univ., NJ); Huse, R. A. pp 1323-1328 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The use of hydrogen for large-scale energy storage, transmission, and distribution is discussed. A numerical example is given for one specific configuration—a fusion reactor linked to an electrolyzer plant. The advantages lie in the abundance of hydrogen, the low cost and high reliability of transmitting energy by pipeline, and the elimination of many constraints on plant siting. Problems arise from inefficiencies in electrolysis and in the reconversion of hydrogen to electricity. These inefficiencies result in more waste heat and drive up costs to the customers. Technological improvements can be expected that will lead to more efficient performances. (auth)

23848 PRODUCTION AND DISTRIBUTION OF HYDROGEN AS A UNIVERSAL FUEL. Gregory, D. P.; Wurm, J. (Inst. of Gas

Tech., Chicago). pp 1329-1334 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Electric power is an expensive energy form to transmit and deliver and cannot readily be stored. A synthetic chemical fuel could be storable and cheaper to transmit. Hydrogen made from nuclear power appears as the cleanest and simplest candidate for an energy-distribution medium. Its combustion products are compatible with the atmosphere. Hydrogen could, in principle, be distributed as universally as natural gas is today, using most of the same technology. But its use would present some new technological problems. It could do all of the jobs done by natural gas, and more. Its universal availability would give rise to new technological opportunities. Transition to a "hydrogen economy" would have to be a well-planned, nationwide operation. Since hydrogen can easily be made today from conventional fossil fuels, it could bridge the gap between the fossil age and the nuclear age by a well-thought-out conversion program. (MCW)

23849 SAFE DISTRIBUTION AND HANDLING OF HYDROGEN FOR COMMERCIAL APPLICATION. Martin, F. A. (Union Carbide Corp., Tonawanda, NY). pp 1335-1341 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The United States Government has used liquid hydrogen for approximately 20 years in their atomic energy research and rocket engine programs. During this period, a commercial business has been established to provide chemical, steel, and the electronics industries with large quantities of this gas. Growing needs for a cleaner, more-powerful, and better-performing fuel will turn toward the use of hydrogen. The equipment, regulations, and procedures that have permitted increased safe commercial usage of hydrogen are discussed. Consideration is also given to some of the problems that still must be overcome to permit the use of hydrogen as a common fuel. (auth)

23850 METAL HYDRIDES FOR ENERGY STORAGE. Wiswall, R. H. Jr.; Reilly, J. J. (Brookhaven National Lab., Upton, NY). pp 1342-1348 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The use of metal hydrides as hydrogen reservoirs facilitates the storage and subdivision of central-station power for automotive and other purposes. Hydrides with a wide range of properties have been synthesized and studied, and several appear to have promise for specific storage applications. Results are reported on the effect of alloy constituents on hydride stability; on the formation of hydrides by metals reacting with gas mixtures such as those produced by the steam reforming of hydrocarbons; and on the feasibility of integrated systems of hydride reservoir plus engine or fuel cell. (auth)

23851 HYDROGEN IC ENGINE: ITS ORIGINS AND FUTURE IN THE EMERGING ENERGY–TRANSPORTATION–ENVIRONMENT SYSTEM. Weil, K. H. (Stevens Inst. of Tech., Hoboken, NJ). pp 1355-1363 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

It is not the internal combustion engine that pollutes the air, but its present fuels. Lower-efficiency-cycle automotive engines and catalytic exhaust treatment are technically unsound and waste remaining hydrocarbon reserves. The hydrogen internal combustion engine's multi-fuel version is the key component of the evolving comprehensive electricity–hydrogen energy system, controlling air pollution and the electric utilities' predicament with low load factors, transmission, and energy storage. Any pragmatic transition rate in time and regional geography may be programmed with this engine—not excluding other promising approaches. To make sound decisions, in time, about realistic compromises based on facts, preparations should begin now. (29 references) (auth)

23852 LIQUID HYDROGEN AS A FUEL FOR MOTOR VEHICLES: A COMPARISON WITH OTHER SYSTEMS. Jones, L. W. (Univ. of Michigan, Ann Arbor). pp 1364-1365 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

Hydrogen as a liquid has obvious advantages as a fuel: relatively high density, use of low-pressure containers, and aesthetic simplicity. On the other hand, the complications of cryogenics handling, boiloff losses, and intrinsic thermodynamic inefficiencies make the virtues of liquid hydrogen not without attendant liabilities. The advantages and disadvantages of the liquid fuel, especially for smaller systems (automobiles and trucks), are explored. The alternative methods of liquid-hydrogen fueling, whether by replaceable tanks or pumping from a storage vessel, are also discussed. (auth)

23853 ECONOMICS OF HYDROGEN FUEL FOR TRANSPORTATION AND OTHER RESIDENTIAL APPLICATIONS. Winsche, W. E.; Hoffman, K. C.; Salzano, F. J. (Brookhaven National Lab., Upton, NY). pp 1366-1374 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

In order to examine the potential role of hydrogen in the nation's energy economy, this paper focuses on the economics of hydrogen delivered to the domestic consumer, the current state of the technology, and the research and development required to implement hydrogen production and delivery systems. Application of hydrogen fuel in domestic energy systems includes the automobile, space heating, cooking, refrigeration, and electrical generation. A comparison is made between several representative energy delivery systems using hydrogen and conventional energy systems using electricity and gasoline. Quantitative information is given on the environmental advantages of hydrogen that make it an attractive and flexible secondary source of energy. The current state of the art is discussed and suggests some areas of technology to be advanced before implementation of hydrogen as a universal fuel. (20 references) (MCW)

23854 HYDROGEN ENGINE IN PERSPECTIVE. Murray, R. G. (Oklahoma State Univ., Stillwater); Schoeppel, R. J.; Gray, C. L. pp 1375-1381 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The latest performance and emission characteristics of the Oklahoma State University air breathing, hydrogen-burning engine are reported. The engine is put in perspective in the future total energy picture. Four years ago development started on the first of a series of hydrogen-fueled engines at Oklahoma State University. Early data indicated that a hydrogen-fueled engine should yield torque, power, and efficiency values comparable to an equivalent spark ignition engine. The performance outlook of this first engine was so optimistic that the Air Pollution Control Office, Environmental Protection Agency funded an effort to study further design improvements and to test its emission characteristics. Recent tests indicate that it should be possible to fabricate a reliable engine to power an automobile or truck. It is expected that this vehicle would have adequate range, normal size, and would fall within a complexity and reliability range similar to today's gasoline counterpart. It would emit no measurable hydrocarbons, organic, or sulfur compounds. Oxides of nitrogen emission below 1976 standards would be expected. (auth)

23855 HYDROGEN–AIR FUELED AUTOMOBILE. Swain, M. R.; Adt, R. R. Jr. (Univ. of Miami, Coral Gables, FL). pp 1382-1387 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The research and development effort required to convert a 1970 Toyota 1600 station wagon to run on a hydrogen–air fuel mixture is described. The unique engine design modifications involve only minor changes to the Otto cycle engine and will not require extensive manufacturer's retooling. In addition a high pressure source of hydrogen is not needed. Total engine cost is expected to be less than that of a similar gasoline fueled low emission engine. An approximately 50% increase in efficiency over that of the gasoline fueled engine is realized. Nitric oxide emissions, the only exhaust gas constituents of concern, are expected to meet the 1975 emission standards. The 1976 and later standards are expected to be met with minor modifications. (auth)

23856 HIGHER-ENERGY FORM OF WATER (H_2O^*) IN AUTOMOTIVE VEHICLE ADVANCED POWER SYSTEMS. Escher, W. J. D. (Escher Tech. Associates, St. Johns, MI). pp 1392-1402 of 7th Intersociety Energy Conversion Engineering Conference. Washington, DC; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The hydrogen–oxygen (stoichiometric) bireactant combination, separately tanked and fed to an advanced-design automotive power plant is addressed. This "higher energy form" of water is compared in terms of: onboard vehicle stored energy, volume, mass

and cost with conventional systems employing gasoline- and hydrogen-fueled internal combustion engines. The higher energy form of water, H_2O^*, will be produced in abundance in future water-splitting hydrogen production facilities using nuclear or solar energy as being envisioned for the post fossil-fuel age "Hydrogen Economy." However, the majority of hydrogen energy conversion system studies so far have addressed hydrogen's reaction with air, not oxygen. If high-temperature H_2O^*-fueled power cycles (3000 to 4000°F) can be developed, a savings in national energy resources of the order of 50% of that needed for present gasoline-fueled automobiles and future hydrogen-fueled vehicles is technically possible. The sole effluent in H_2O^* combustion is the lower energy form of water. (MCW)

23857 SOLAR-ELECTRIC RESIDENTIAL POWER SYSTEM. Backus, C. E. (Arizona State Univ., Tempe). pp 704-711 of 7th Intersociety Energy Conversion Engineering Conference. Washington; American Chemical Society (1972).

From 7th intersociety energy conversion engineering conference; San Diego, California, USA (25 Sep 1972). See CONF-720925-.

The technical feasibility of using a solar cell covered roof on a private residence to provide all of the energy requirements of the home was investigated. The energy storage was by electrolysis of water coupled with a fuel cell. The daily and monthly variations in solar energy in the Phoenix area and the projected energy demands of a home were taken into account. The reference design of the system uses present-day technology and the parameters assumed are conservative. A parametric analysis of the system indicated the sensitive components and the potential of future systems. The reference design system would have no trouble in supplying the energy demands of the home except for a few days in December. An energy storage capacity of more than four days would be required for that period. This system could also produce about 700 lb of excess hydrogen per year that could be used as an energy source for other systems. Although this solar-electric system is technically very feasible, its attractiveness will require a large reduction in the cost of solar cells. (auth)

23858 POWER PLANT GAS TURBINE AND ITS DEVELOPMENT PROSPECTS FROM RUSSIAN ASPECT. Kirillov, I. I.; Arsenev, L. V. Arch. Energiewirt.; 27: No. 11, 514-531(1973). (In German).

A review is given on the most important problems and various possibilities of application of the gas turbine. (GE)

23859 COMMON EUROPEAN POWER SUPPLY POLICY. Reichert, K. (Commission of the European Communities, Brussels). Elektrizitaetswirtschaft; 72: No. 12, 387-391(1973). (In German).

The Commission for the European Community has worked out new plans and proposals for a power policy in the Community, in view of the change in the world power situation. The Council of Ministers decided on May 22, 1973 that the guidelines and urgent measures put forward by the Commission were suitable as a basis of discussion along general lines. (GE)

23860 STATE OF THE POWER GENERATION AROUND THE MIDDLE OF 1972. Energie; 25: No. 4, 94-97(1973). (In German).

Data from the Annual Plant Design Report, Power, Nov. 1972, are used to discuss stationary plants for steam and electricity generation, involving nuclear power and water power plants. Primarily, turbines and pressure vessels are considered. (GE)

23861 NUCLEAR POWER AND THE ENVIRONMENT. Grendon, A. Forum (Chicago); 8: No. 1, 70-92(Fall 1972).

The source of power for the next several decades must be between fossil fuel and nuclear fission. The discussion involves how nuclear power compares with the alternatives with respect to environmental effects. Nuclear fission provides a new source of energy to supplement the older resources, fossil fuels and water power. Nuclear fission power is being applied as heat to make steam to run turbines and generate electricity; to use the heat for distillation of salty or brackish water in order to augment the diminishing water supply; and to use steam from nuclear reactors in industrial processes and domestic heating. Objectionable waste heat could be used to prevent the undesired freezing of lakes and to enhance the productivity of farmlands by warm water irrigation. The undesirable effects involve the routine discharge of radioactive materials into the air and water, possible accidents during transport of nuclear materials, and safety hazards at the plants. Alternatives discussed include expanded use of fossil fuel plants and hydroelectric plants; and development and use of solar energy, geothermal energy sources, tidal power, wind, and fusion nuclear power. The possibility of reduced electricity use and an increase in the efficiency of electric generation by the use of MHD are suggested. (MCW)

23862 QUESTIONS OF THE HOUR IN ELECTRICITY SUPPLY. Schulte, R. (VEW AG, Dortmund, Ger.). Elektrizitaetswirtschaft; 72: No. 12, 376-380(1973). (In German).

From meeting of the Vereinigung Deutscher Elektrizitaetswerke; Duesseldorf, Germany (22 May 1973).

The question of whether the energy gap of the eighties is an unavoidable event, or whether, even before the end of the seventies, the reliability of power supply may be called into question by reason of lack of capacity are discussed. The basic requirements which in the opinion of the electricity supply authorities must be taken into account when working out an overall energy policy are stated by Dr. R. Schulte to be to ensure: the availability of the primary energy, capital development in accordance with demand and the financing requisite for this. A comprehensive discussion is given of the conditions that must be met if the aim of a medium and long-term reliable electricity supply is to be achieved in the Federal Republic. Dr. Schulte describes the measures necessary to reduce the risks to supplies of mineral oil; for the optimum utilization of the reliable energy sources lignite, nuclear energy, and natural gas; for consolidating the position of German coal mining and to solve the conflicts between environmental protection and power supply. (GE)

23863 LAST PLAY. The Struggle to Monopolize the World's Energy Resources. Ridgeway, J. New York; E. P. Dutton and Co., Inc. (1973). 453p. $10.00.

Monopoly in energy is discussed in Part I in six chapters and a concluding chapter. They are: The Energy Crisis, Lewis and Love, The New Energy Industry, March into the Canadian North, Southeast Asia Co-Prosperity Sphere, and The New Alliances. Part II is entitled "A Guide to the Energy Industry," and the ten chapters are entitled; Oil, Natural Gas, Uranium, Coal, Transportation, U. S. Electricity, Future Fuels, China, Major Energy Corporations, and Financial Institution Control of Energy Companies. (MCW)

23864 OPTIMIZATION OF POWER SUPPLY SYSTEMS. Neumann, G. (Berliner Kraft- und Licht, Ger.). VGB Kraftwerkstechnik; 53: No. 7, 434-442(1973). (In German).

A method of representing design problems with graphs in such a way that their solution by means of dynamic programming is self-evident. With further development the procedure described can become an important instrument of investment policy for power supply undertakings. (GE)

23865 ENVIRONMENTAL IMPACT: CONTROLLING THE OVERALL LEVEL. Westman, W. E. (Univ. of Queensland, Brisbane, Australia); Gifford, R. M. Science; 181: No. 4102, 819-825(31 Aug 1973).

Current environmental problems stem from the interactions of the size and rate of growth of the human population, the growing per capita consumption of products, and the increasing use of products and technologies that are more pollution-generating and wasteful of resources. The Club of Rome report puts the case vividly that unchecked growth of each of these elements of environmental impact is incompatible with the perpetuation of human civilization. An equitable system of resource allocation (Natural Resource Unit) that could be made to act as such a rapid, anticipatory feedback system, while placing an artificial cap on the overall impact that society is making on the environment, is described. The kinds of environmental impact that might be rationed by the scheme are pollution of air, water, and land; destruction or disturbance of valued species' habitats, ecosystems, and scenery; extraction and use of recyclable and nonrecyclable physical resources; contribution to human population pressure; and transitory, immediately reversible disturbance to individuals' local environment (for example, noise). In summary, it is suggested that by assigning to every resource use and activity (including childbirth) that causes environmental impact a price in money-independent units (NRU's), the new system of environmental trade-offs can be established that maintains maximum personal choice within overall environmental constraint. The social equality of the system in relation to resource exploitation would be enhanced by distributing NRU rations equally among the population each year. (MCW)

23866 GEOTHERMAL HEATS UP. Environ. Sci. Technol.; 7: No. 8, 680-681(Aug 1973).

The first successfully tapped sources of geothermal steam were put into use in Larderello, Italy in 1904 and are still producing electricity today. The steam at Larderello is clean and dry. In the United States, most geothermal steam is mineral-laden and confined to the West. Corrosion, solid-waste disposal, and transport of the steam to urban areas are factors to be considered. Some of the geothermal wells drilled in the Imperial Valley in California yield less than 20% steam, the rest being superhot brine. The salinity of this 80% hot water fraction may be 20 to 30 times as high as that of seawater. The Geysers geothermal field in the mountains 90 miles north of San Francisco produces dry steam. Technology for using hot water geothermal sources is being devel-

oped. It is projected that geothermal resources do constitute a large, untapped source of energy, water, and minerals. (MCW)

23867 RACCOON MOUNTAIN PUMP/TURBINES ARE WORLD'S LARGEST. Energy Int.; 10: No. 1, 18-20(Jan 1973).

The four 400-MW reversible pump/turbines ordered for the Tennessee Valley Authority's Raccoon Mountain pumped-storage project are the largest machines of their type ever built. The design and fabrication techniques used are described. (LCL)

23868 SUPERCONDUCTING MOTORS POINT WAY TO HIGHER GENERATOR RATINGS. Appleton, A. D. (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). Energy Int.; 10: No. 1, 13-16(Jan 1973).

Experience with a superconducting motor in a British power station is described. This has stimulated interest in the development of superconducting a.c. generators which would be economic at unit ratings far greater than are attainable with conventional designs. (auth)

Information Handling

23869 (DP-MS-72-65) DATA MANAGEMENT FOR SCIENTIFIC MODULAR SYSTEMS. Knight, F. D.; Jensen, J. C.; Parker, C. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd] Contract AT(07-2)-1. 13p. (CONF-730314-7). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

Data management for the scientific modular system JOSHUA is discussed. An explanation of the user interface, the information structure, the physical storage organization, and the data management program is given, along with the access methods for handling the physical data transfer. Statistics are presented reflecting operation in both an interactive terminal environment and a multiprogramming batch environment. (auth)

23870 (JUL-909-MA) ADVIDA: A DATA BANK SYSTEM FOR AN INSTALLATION WITH VIRTUAL STORAGE. Boenke, W.; Groten, G.; Meis, T. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik). Dec 1972. 29p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

23871 (SGAE-2123) ZAED DESCRIPTION OF A DOCUMENTATION SYSTEM. Nevyjel, A. (Oesterfeichische Studiengesellschaft fuel Atomenergie G. M. B. H., Seibersdorf. Mathematikabt). Apr 1973. 9p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The historical development and task today of the ZAED are explained. The working method for literature collection, processing, and output for the user are described and conclusions for adapting a documentation system within the SGAE are made. (auth)

23872 (UCRL-74884) DISCIPLINE INDEPENDENT ASPECTS OF DATA BANK ORGANIZATION. Howerton, R. J. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Jul 1973. 14p. (CONF-730719-2). Dep. NTIS $3.00.

From the CODATA symposium on man-machine communication for scientific data handling; Greiburg, F. R. Germany (22 Jul 1973).

The following points are discussed: (1) numerical data and bibliographic reference data should be linked by a reference accession number; (2) most disciplines are to a greater or lesser degree self-organizing; (3) telephone-book types of listings or graphical displays should be produced routinely rather than resorting to online interaction; (4) selected permuted indexes to both the bibliographic information and the numerical data files should be produced routinely; (5) default options should be avoided when designing an encoding system; and (6) output modes should be designed to be convenient to the user. (auth)

Law

Refer also to abstract 21482.

23873 (EUR-4906) PRACTICE OF PUBLIC CONTROL ON THE OBSERVANCE OF EXEMPTION FOR NUCLEAR FUELS AND OTHER RADIOACTIVE MATERIALS IN THE MEMBER COUNTRIES OF THE EUROPEAN COMMUNITIES. Bischof, W.; Pelzer, N. (Goettingen Univ. (West Germany). Institut fuer Voelkerrecht). Apr 1973. 451p. (In German). Dep. NTIS (U. S. Sales Only) $24.75. EUR BF 750,-.

The comparative study carried out by the Institute for International Law at Goettingen University provides an overall view of the control and information from the responsible authorities of the member states regarding radioactive materials which are not subject to notification and previous permission. It supplements the study already published by the Commission of the European Communities in EUR-report 4515 of the national legal and administrative regulations governing the notification and approval procedures for radioactive materials, issued on the basis of the Euratom radiation protection standards. (auth)

23874 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1974. Part 2. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, First Session on Regulation; Nuclear Materials; Biomedical, and Environmental Research; Physical Research, February 6, 21, and 22, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 950p. GPO $4.30.

23875 NUCLEAR SAFETY, RADIATION PROTECTION, AND LEGISLATION IN THE NETHERLANDS. Weber, J. (Interuniversitair Reactor Instituut, Delft, Netherlands). pp A.1.1-A-1.4 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol; Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

In 1963, the parliament accepted a new nuclear law, which provides a general legal frame for the promoting and protecting aspects of nuclear energy. After completion of the various decrees the entire nuclear law came into force in 1970. The system of ministerial decrees based on one central law has the advantage of flexibility, as small adjustments do not require alteration of the law. In general, the new decrees adopt the policy laid down in the provisional legislation and is executed by the same governmental departments. All work with radioactive substances and radiation requires a license; exempt from the regulations are radioactive substances of which the activity is below certain limits. One of the new aspects is the supervision of radiological work by qualified experts. Discharges in air and water are severely limited in the Netherlands. An understandable attitude is our overpopulated country, where water supply and water discharge are constant problems. Solid waste can be discharged freely if its specific activity is below 2 nCi/g. This limit, which is incorporated in most national laws, belongs — in my opinion — to the most disputable ones. (auth)

Management

Refer also to abstracts 24005 and 24073.

23876 (HW-70935) EMERGENCY RADIOLOGICAL PLANS AND PROCEDURES. Heid, K. R. (ed.). (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 21 Dec 1962. 238p. Dep. NTIS $14.00.

Even though all practical measures are taken to minimize the probability of a serious radiation event occurring at the HAPO, there will always remain the possibility that such an event can occur. The intent of this manual is to provide improved capability for coping with such an event. It is not intended that these plans and procedures be considered as inflexible courses of action which cannot be deviated from, but rather that they serve as guides to supplement the use of good judgment. Any emergency action should be directed toward a goal of minimizing personnel exposures. (auth)

23877 (JAERI-M-4615) HEALTH PHYSICS AND SAFETY IN JAERI. Annual Report No. 13, April 1, 1970–March 31, 1971. (Japan Atomic Energy Research Inst., Tokyo). Feb 1972. 128p. (In Japanese). INIS.

In this report and subsequent issues, the activities in Takasaki Radiation Chemistry Research Establishment and Oarai Research Establishment are also included, whereas the past issues were only for the Tokai Research Establishment. Topics covered include administration and radiation control, development of techniques, and health physics research. Reports thus cover not only the works for research reactors and laboratories but also those for radiation utilization facilities and larger nuclear reactors. The research and development in health physics is extensive and includes that for the entire JAERI. (INIS)

23878 (RD/B/M-2654) CHEMICAL SAFETY HANDBOOK. Dominey, D. A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Apr 1973. 53p. Dep. NTIS (U. S. Sales Only) $4.75.

The safety handbook is for the guidance of staff at Berkeley Nuclear Laboratories. It draws attention to the hazards associated with using particular chemicals, describes methods of safe handling, and includes advice on the disposal of chemicals. Among the materials covered are liquid metals, compressed gases, metal powders, organic solvents, and toxic and potentially explosive chemicals. (auth)

23879 (UCRL-74781) DEVELOPMENT OF A HAZARDS CONTROL DEPARTMENT. DiGrazia, H. X. (California Univ., Livermore. Lawrence Livermore Lab). 31 May 1973. 6p. (CONF-730552-1). Dep. NTIS $3.00.

From southern area research and development safety symposium; Tullahoma, Tennessee, USA (7 May 1973).

The development of programs for radiation protection and safety at Lawrence Livermore Laboratory is described. Only administrative details are discussed. (CH)

23880 REPORTS AND ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 1973. Amersham, Eng.; Radiochemical Centre Ltd. (1973). 16p.

A report is presented on the business activities of the Radiochemical Centre Limited in the field of radioactive products, under the following headings: directors and officers, chairman's statement, report to the directors, consolidated profit and loss account, consolidated balance sheet, parent company balance sheet, notes on the accounts, report of the auditors to the members. (UK)

Mathematics and Computers

Refer also to abstract 21026.

23881 (AECL-4519) CRAGRO: A FORTRAN IV PROGRAMME FOR FRACTURE MECHANICS ANALYSIS. Hosbons, R. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jul 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50. AECL $0.50.

This report describes the mathematical basis of a computer program which calculates critical crack sizes and fatigue lives of engineering components using fracture mechanics data. The program is described together with the input data required for its use. The program uses principal stresses and resolves the stress normal to the crack. Both uniform and nonuniform stresses can be used in the analysis. (auth)

23882 (CONF-730704-1) SERENDIPITY: A WATERSHED LEVEL SIMULATION MODEL OF TREE BIOMASS DYNAMICS. Goldstein, R. A.; Harris, W. F. (Oak Ridge National Lab., Tenn.). 1972. 6p. Dep. NTIS $3.00.

From summer simulation conference; Montreal, Canada (17 Jul 1973).

Serendipity is a deterministic model developed to simulate tree biomass dynamics of a closed-canopy, forested watershed on a year-to-year basis. The accumulation of biomass for a mixed deciduous forest was simulated using parameters derived from stand inventory data on Walker Branch Watershed. Simulation of forest responses give good agreement with observed patterns of stand production on the watershed. Suggestions for improving quantitative agreement as well as a possible conceptual limitation to improvement are discussed. (auth)

23883 (COO-1469-227) ANNUAL REPORT, SEPTEMBER 1, 1972-AUGUST 31, 1973. Gear, C. W. (Illinois Univ., Urbana. Dept. of Computer Science). 1973. Contract AT(11-1)-1469. 60p. Dep. NTIS $5.00.

This report is divided into three sections: (1) numerical methods, (2) nonnumerical software, and (3) minicomputer system. A detailed description of work during this period is given for each. (MOW)

23884 (COO-2271-14) NEW REARRANGEMENT INEQUALITY FOR MULTIPLE INTEGRALS. Luttinger, J. M.; Friedberg, R. (Columbia Univ., New York. Dept. of Physics; Barnard Coll., New York). [nd]. 42p. Dep. NTIS $4.25.

23885 (HMI-B-136) NEW GRAPHIC TABLET FOR DIGITAL COMPUTERS. Glauert, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). May 1973. 114p. (In German). Dep. NTIS (U.S. Sales Only) $7.75.

A review is given of known methods to construct graphic tablets, i.e., devices which allow the automatic measurement of the position of a stylus on a drawing board and the transmission of these data to a computer in digital form. A new method is presented using the propagation of electromagnetic waves along a special delay line. The position of the stylus is measured by evaluation of a phase-angle. A summary of the requirements of such graphic tablets is given. It is considered also how the transmission of redundant data to the computer could be prevented or reduced. Some aspects of a prototype device using the new method are described. 500 coordinate-pairs per second are measured. The encoding surface provides an active area of 1024 × 1555 units, 250 mm × 380 mm respectively. (auth)

23886 (IFA-CO-27-1972) COMPUTING PROGRAM FOR INTERPRETING ESR SPECTRA OF ORGANIC FREE RADICALS. Pomponiu, C.; Balaban, A. T. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

A computer program was developed for interpreting ESR spectra of organic free radicals possessing atoms of nuclear spin $\frac{1}{2}$ and 1. It is based on the assumption that coupling constants can be expressed in terms of integers, leading to the solving of a diophantine equation. Input data are numbers of coupling atoms with their nuclear spins, numbers of equidistant lines in the spectrum (even if lines are not equidistant, the spectrum can be accommodated by including zero-intensity lines at points separated by the smallest equidistance λ), experimentally measured intensities of all lines except the two marginal ones, and relative errors in determining intensities. The program output gives the theoretical intensities and the number of atoms of spin $\frac{1}{2}$ and 1 with their coupling constants expressed in terms of λ. These solutions can then be refined using a spectrum simulator, thus removing the restriction that all coupling constants must be multiples of λ. (auth)

23887 (IS-3147) CRITERIA FOR ORDERING COLUMNS IN TWO-DIMENSIONAL PROJECTION METHODS. Georg, D. D.; Keller, R. F. (Ames Lab., Iowa). Jun 1973. Contract W-7405-eng-82. 61p. Dep. NTIS $5.45.

The two-dimensional projection method is an iterative method for solving systems of linear algebraic equations. The method modifies two components of the approximate solution vector at each step by using two corresponding column vectors of the coefficient matrix. This paper investigates criteria for ordering the columns of the coefficient matrix. (MOW)

23888 (KFKI-72-74) COMPUTERIZED MEASUREMENTS AND DATA PROCESSING. Program for the Elimination of Instrument Distortions and Improvement of Resolution. Szoke, J. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr 1973. 64p. Dep. NTIS (U.S. Sales Only) $5.25.

A computer program using an iterative deconvolution algorithm for the generation of genuine (instrument-independent) spectra and for the improvement of resolution is described. (auth)

23889 (KFKI-73-25) COMPUTER PROGRAM FOR THE CALCULATION OF FORCE CONSTANTS USING THE GENERALIZED INVERSE MATRIX. Gellai, B.; Jancso, G. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

A FORTRAN program for the calculation of force constants using the generalized inverse of the Jacobian matrix is described. The method can be applied with success to solve "ill-conditioned" problems since it effectively removes the singularity difficulties in the least squares problems. Detailed instructions for the use of the program together with test results are given also. (auth)

23890 (LA-UR-73-478) COMPARISON OF MADCAP AND SETL. Morris, J. B. (Los Alamos Scientific Lab., N. Mex.). 1973. 27p. (CONF-731001-1). Dep. NTIS $3.50.

From symposium on principles of programming languages; Boston, Massachusetts, USA (1 Oct 1973).

A brief outline is given of the research directions and goals of these two programming languages. The similarities and differences between the two languages are described. (auth)

23891 (MRR-118) THEORY OF THE ANALYSIS OF CHECKING PROCEDURES FOR PROGRAMS. Ehrenberger, W. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Apr 1973. 81p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

The number of tests, which is necessary to prove the correctness of a program, can be reduced to a small value, if the structure of the program is investigated. The analysis starts from the memory dump. The program first is divided into its pieces, which are run purely sequentially. Then the mappings of the program and their input and output arrays are identified, along with those arrays that influence branches. The next step states which ranges of values in the individual arrays are distinguished by the program and which junctions of arrays are relevant. From this, the kind and the number of necessary tests can be derived. By observing their main variables, loops are divided into simpler structures. (auth)

23892 (ORNL-4778(Supp. 1)) KWIC INDEX FOR NUMERICAL ALGEBRA. Householder, A. S. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 109p. Dep. NTIS $5.45.

This volume supplements ORNL-4778 partly with recent publications, partly with translated titles inadvertently omitted before, partly with the addition of new review references, and partly with the inclusion of a few titles hitherto overlooked. (auth)

23893 (SGAE-2132) PDUP PARTIAL DUMP. Accessory Test for the Testing of PDP 11 Assembly Program. Krotz, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H.,

Seibersdorf. Mathematikabt). May 1973. 7p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The assembler program PDUP is called using the macro PDUP; it serves for dumping the registers or a main storage area or both in octal form. (auth)

23894 (SLA-73-674) DYNAMIC MODELING OF SOLID-STATE DEVICES USING OPTIMIZATION TECHNIQUES. Peterson, B. R. (New Mexico Univ., Albuquerque). Aug 1972. 139p. Dep. NTIS $9.00.

For Sandia Labs., Albuquerque, NM.

A method of parameter-value determination is described wherein numerical optimization techniques are coupled with dynamic time-domain modeling. Using a simple test circuit and a predetermined input, a time-domain output waveform is measured. This waveform is entered into the computer as data defining a desired response. Then, given a model configuration, the computer simulates the model response to the same input, and adjusts the model parameters to make an "optimal" fit between the simulated and measured output. (LMT)

23895 PROGRAMMING SYSTEM FOR COMPUTER CONTROLLED EXPERIMENTS. Pfeiffer, K. (Kernforschungsanlage, Juelich, Ger.). (1972). vp. (In German).

From information meeting: data processing in research; Juelich, Germany (12 Oct 1972).

A description is given of the implementation of a programming system for small computers (like PDP-8) which are used for process control of nuclear experiments (with CAMAC-periphery) at the Nuclear Research Facilities Juelich. An account of the situation is given followed by a description of the programming language FOCAL (similar to BASIC). The catalogue of changes due to FOCAL implementation is discussed. (GE)

23896 EXPERIENCES WITH THE TIME-SHARING SYSTEM AT THE NUCLEAR RESEARCH CENTER KARLSRUHE. Stittgen, H. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German).

From information meeting: data processing in research; Juelich, Germany (12 Oct 1972).

A short account is given of the configuration (IBM/360-65 and IBM/370-165) and the user frequencies. The four time-sharing systems (terminal control program, display system, APL, TSO) used in the Nuclear Research Center Karlsruhe are discussed mainly with respect to further developments, taking into account the man-machine relations. (GE)

23897 PROCESSING EXPERIMENTAL DATA BY A TIME-SHARING COMPUTER. Moritz, H. E. (Kernforschungsanlage, Juelich, Ger.). (1972). vp. (In German).

From information meeting: data processing in research; Juelich, Germany (12 Oct 1972).

A survey is given of a study to couple peripheral computers at experimental stations in the Nuclear Research Facilities Juelich to a central time-sharing computer IBM/360-67. Some prerequisites of the system design are: high availabilities, high protection against data losses, independence computers at experimental stations, flexibilities, possibility of expansions etc. The hardware structure, internal sequences, and user aspects of the system are discussed. (GE)

Miscellaneous

Refer also to abstract 21976.

23898 (AEC-tr-7446) USE OF POTENTIODYNAMIC CURVES FOR THE STUDY OF CORROSION INHIBITORS OF IRON–NICKEL–CHROMIUM ALLOYS. Aries, L.; Triche, H. Translated From Mem. Sci. Rev. Met.; 64: No. 11, 947-952(1967). 12p. Dep. NTIS $3.00.

23899 (AERE-R-6996) TECHNIQUES FOR THE MEASUREMENT OF THE SEMICONDUCTOR PROPERTIES OF THERMOELECTRIC MATERIALS. Ryden, D. J. (Atomic Energy Research Establishment, Harwell (England)). May 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

Semiconductors used in thermoelectric devices have properties lying between those of metals and the more usual electronic device semiconductors. Techniques that may be used to measure resistivity, the Seebeck coefficient, the thermoelectric "figure of merit," the thermal conductivity, and the Hall coefficient are discussed. An outline of the various measurement methods is given, and those aspects that experience has shown to be a problem are discussed. The pieces of apparatus used in this laboratory are described, and estimates of the accuracy that may be expected are given. (auth)

23900 (ANL-8018) RESEARCH ON OXYGEN RECOVERY SYSTEMS FOR USE IN SPACE CAPSULES. Progress Report, February 1972–January 1973. Selman, J. R.; Steunenberg, R. K.; Cairns, E. J. (Argonne National Lab., Ill.). Feb 1973. Contract W-31-109-eng-38. 54p. (NASA-CR-114573). Dep. NTIS $5.45.

An electrochemical process is being studied for O_2 recovery: $CO_2 + \frac{1}{2}H_2O \rightarrow \frac{1}{2}C_2H_2 + \frac{5}{4}O_2$. A modified cell and a gas supply system was developed, and results of initial experiments are reported. (DLC)

23901 (AP-104-P1) BIOLOGICAL ASPECTS OF LEAD: AN ANNOTATED BIBLIOGRAPHY. Part I. Literature from 1950 Through 1964. Campbell, I. R.; Mergard, E. G. (Cincinnati Univ., Ohio (USA). Kettering Lab.). May 1972. 567p. GPO $6.75 per set.

23902 (AP-104-P2) BIOLOGICAL ASPECTS OF LEAD: AN ANNOTATED BIBLIOGRAPHY. Part II. Literature from 1950 Through 1964. Campbell, I. R.; Mergard, E. G. (Cincinnati Univ., Ohio (USA). Kettering Lab.). May 1972. 369p. GPO $6.75 per set.

23903 (BARC-652) WATER CHEMISTRY X-CONTINUOUS MONITORING OF CHLORIDE ION CONCENTRATION IN THE RANGE 10 to 500 P.P.M. USING A SPECIFIC ION ELECTRODE. Narasimhan, S. V.; Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

23904 (BDX-613-842(Rev.)) CHARACTERIZATION OF CONATHANE EN-4 URETHANE RESIN. Caruthers, D. J. (Bendix Corp., Kansas City, MO). Aug 1973. Contract AT(29-1)-613. 37p. Dep. NTIS $4.00.

High-voltage protection of electrical components is provided by Conathane EN-4 manufactured by Conap Incorporated. EN-4 is a polybutadiene based isocyanate resin cured with a polyol blend. The material has better hydrolytic stability and a lower compressive modulus than either the polyether or polyester castable urethanes. (auth)

23905 (BDX-613-888(Rev.)) ULTRASONIC WELDING OF NYLON CELL CASES ON A NICKEL–CADMIUM BATTERY. Bengtson, G. W. (Bendix Corp., Kansas City, MO). Aug 1973. Contract AT(29-1)-613. 21p. Dep. NTIS $3.25.

A joint design and ultrasonic welding schedule capable of making a leak-tight pressure joint in nylon was developed. This will permit the replacement of polystyrene with nylon for cell cases on a nickel–cadmium battery. (auth)

23906 (BDX-613-897) CHARACTERIZATION AND SCHEDULE DEVELOPMENT FOR GOLD-RIBBON HYBRID-MICROCIRCUIT CROSSOVERS. Willyard, D. L. (Bendix Corp., Kansas City, MO). Jun 1973. Contract AT(29-1)-613. 45p. Dep. NTIS $4.00.

This work was conducted to establish a microcircuit intraconnection bonding process with rectangular gold ribbon and a Model 1360-2 Radiant Energy Systems bonder. These crossover intraconnections consist of conductive elements added to metallized substrates to connect one circuit path to another without contacting other circuits over which they pass. This work was performed on tantalum/chromium/gold-metallized alumina substrates with only the one bonding system, the purpose being to determine the optimum combination of bonding parameters. Both ultrasonic and thermocompression bonding were evaluated, including the inherent deficiencies of gold for ultrasonic bonding, and a schedule was established for one size of gold ribbon. Pull-strength tests verified adequate bond strength. The process is adaptable to other microcircuit bonding applications by making minor parameter adjustments. (23 figures) (auth)

23907 (BDX-613-932) PANTOGRAPH POSITIONING SYSTEM FOR INSPECTING MICROCIRCUITS. Taylor, R. D. (Bendix Corp., Kansas City, MO). Jun 1973. Contract AT(29-1)-613. 16p. Dep. NTIS $4.00.

A pantograph positioning system was developed to facilitate locating the areas on hybrid microcircuits that require visual inspection under high-power microscopes. The system significantly increases the speed and reliability offered by manual positioning methods. (auth)

23908 (BNL-18015) INVESTIGATION OF BONDING AND CHARGE TRANSFER IN ALLOYS AND COMPOUNDS BY X-RAY DIFFRACTION. Welch, D. O.; Keating, D. T. (Brookhaven National Lab., Upton, N. Y). 1972. 13p. (CONF-730554-2). Dep. NTIS $3.00.

From meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Philadelphia, Pennsylvania, USA (29 May 1973).

In principle, x-ray diffraction provides a means of directly determining the electron distribution in crystals, and thus of

yielding parameters which unambiguously characterize electron redistribution due to charge transfer and covalent bond formation in alloys and compounds. In practice, these parameters are usually determined from small differences between the observed scattering and that calculated on the basis of free atom wave functions or by a truncated Fourier inversion of diffraction data after subtracting the assumed contribution from core electrons. Therefore, not only is x-ray data of high quality required, but the effect of various unavoidable sources of experimental error and of uncertainties inherent in the analysis of data must be carefully assessed. The different models and conventions used in the description of valence-electron distributions in crystals are discussed with reference to experimental data for several alloys, compounds, and elements illustrating bonding or charge transfer effects. (auth)

23909 (BNL-18019) SHORT AND LONG-TERM APPROACHES TO THE "ON AND OFF" PHENOMENON. Papavasiliou, P. S.; Cotzias, G. C.; Mena, I. (Brookhaven National Lab., Upton, N. Y.). 1973. 15p. (CONF-730456-1). Dep. NTIS $3.00.

From second U. S. and Canadian conference on parkinson's disease; Princeton, New Jersey, USA (11 Apr 1973).

A short-term reversal of the "on and off" phenomenon was imposed by injections of apomorphine (1 to 3 mg, s.c.). Although this reversal by apomorphine was effective in all patients studied, it was not fully satisfactory because it was often accompanied by re-emergence of preexisting dyskinesia. By contrast, the long-term combined dietary-pharmacological regimen described here (which was not effective in all patients) appeared devoid of this drawback and is therefore worthy of fastidious confirmation. (auth)

23910 (BNL-18064) EXPERIMENTAL DATA ON PARTICULATE DISPERSION INTO AND WITHIN A FOREST. Part II. Dispersion from Upwind Area Sources. Raynor, G. S.; Hayes, J. V.; Ogden, E. C. (Brookhaven National Lab., Upton, N. Y.). Jun 1973. 40p. Dep. NTIS $4.00.

23911 (BNWL-1751(Pt. 1), pp 22-26) EVALUATION OF HI-VOLUME CASCADE PARTICLE IMPACTORS. Sehmel, G. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Commercially available 20-cfm cascade particle impactors were evaluated for sampling errors caused by wall losses and by impactor orientation. Particle wall loss on the impactor walls increased with both an increase in stage soil collection and an increase in airborne particulate concentration. The particle size distributions obtained with the impactors are biased if the sampler inlet is not directed into the prevailing wind. (auth)

23912 (BNWL-1751(Pt. 1), pp 85-87) TRACE METAL ANALYSIS BY ATOMIC ABSORPTION SPECTROMETRY USING A GRAPHITE FURNACE ATOMIZER. Lee, R. N. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

Atomic absorption spectroscopy using a carbon furnace technique was evaluated to determine its applicability to atmospheric tracer and pollution studies. Observed analytical sensitivities for a number of metals are reported. (auth)

23913 (BNWL-1751(Pt. 1), pp 101-103) AEROSOL GENERATOR SYSTEM FOR SEQUENTIAL TRACER RELEASE. Thomas, C. W.; Rieck, H. G. Jr.; Young, J. A.; Wogman, N. A. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

23914 (BNWL-1751(Pt. 1), pp 140-142) SYSTEM FOR MEASURING PARTICLE SIZE DISTRIBUTIONS. Alkezweeny, A. J. Apr 1973.

In Pacific Northwest Laboratory annual report for 1972 to the USAEC Division of Biomedical and Environmental Research. Vol. II, Pt. 1.

23915 (CEA-CONF-2282) APPARATUS FOR SAMPLING TRACE AMOUNTS OF GASEOUS FLUORINE DERIVATIVES IN THE AIR (FLUORMATIC). Perilhon, P.; Chevallier, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 9p. (In French). (CONF-721095-1). Dep. NTIS (U. S. Sales Only) $3.00.

23916 (CEA-R-4360) INFLUENCE ON THE INTERACTION BY FUNCTIONAL GROUPS IN SOME SERIES OF BICYCLO-(2,2,1)-HEPTANE DERIVATIVES. Gagnaire, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jun 1973. 138p. (In French). Dep. NTIS (U. S. Sales Only) $9.00.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble.

23917 (CEA-R-4423) MECHANICS OF COMPOSITE EXPLOSIVE MATERIALS. Poulard, S.; Sorel, J.; Lucas, G.; Theys, P. (Commissariat a l'Energie Atomique, Vaujours (France). Centre d'Etudes). Jul 1973. 70p. (In French). Dep. NTIS (U. S. Sales Only) 15.50.

A theoretical approach is proposed to verify the macroscopic behavior of composite explosive materials at first approximation. (JRD)

23918 (CEA-R-4466) FLUORESCENCE QUANTUM YIELD MEASUREMENTS OF POWDERS AND SOLUTIONS BY SPECTROFLUORIMETERS WITH OR WITHOUT INTEGRATING SPHERE. Billon, D.; Laine-Boeszoermenyi, M.; Fallot, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etude Nucleaires). Jul 1973. 43p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

Measurements were carried out, using two methods, on National Bureau of Standards powders and quinine sulfate solutions. Errors are estimated. The quantum yield of deuteroporphyrin dimethylester was measured with both methods and found to agree. (DLC)

23919 (CNEA-337) EFFECT OF COMPLEMENT ON THE VELOCITY OF THE ANTIGEN-ANTIBODY REACTION. Degiorgi, E.; Borella, L. D.; Scavini, L. M.; Capalbo, E. E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 11p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

23920 (CNEA-338) IMMUNE TOLERANCE TO HETEROLOGOUS ALBUMIN. I. Quantitative Radioimmunoelectrophoresis of Immune Response. Borella, L. D.; Scavini, L. M.; Capalbo, E. E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

A technique to quantitate antibodies by means of radioisotopes (^{125}I) and immunoelectrophoresis is described. Schematically, it consists in electrophoresis of the test antiserum followed by immuno-diffusion with immune serum directed only against immunoglobulins. After that, in the same trough the labeled specific antigen is placed and allowed to diffuse to reach the corresponding immunoglobulin arc. In the following step, radioautography is performed to identify the specific antibody against labeled antigen, and the piece of agar with it is cut and the radioactivity is measured in a well scintillation counter. With a modified Farr technique it was observed in one experiment on tolerance to bovine serum albumin (BSA) that, unlike the results reported by Dietrich and Weigle, more than 50% of mice reinjected one month after the neonatal injection of 20 mg of BSA, produced antibodies to BSA. (auth)

23921 (CNEA-339) IN VIVO STUDIES OF THE HUMAN THYROID STIMULATING HORMONE. Carneiro, M.; Cabrejas, M.; Watanabe, T.; Barmasch, M.; Altschuler, N.; Mitta, A. E. A.; Degrossi, J. O. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 16p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Utilizing human labeled TSH and the single-injection kinetic method, the metabolic behavior of TSH was studied. A two-compartment model was developed using the SAAM computer program and an IBM 360-50 digital computer. Interpretation of the data obtained and the methods used by other investigators and of the production rate observed in hyperthyroidism is discussed. (LMT)

23922 (CONF-710357) PROCEEDINGS OF XV IUFRO CONGRESS, GAINESVILLE, FLORIDA, MARCH 14–20, 1971. (International Union of Forestry Research Organizations). 1971. 326p. (In Several Languages).

Research programs on forest management throughout the world are reviewed with emphasis on programs in Europe and the USA. Forest uses and the economics of forest products are also discussed. (CH)

23923 (CONF-730342-1) LOW-FREQUENCY MODES IN THE RAMAN SPECTRA OF POLYETHYLENE AND PARAFFINS. I. Lattice Vibrations and Their Pressure Dependences. Wu. C. K.; Nicol, M. (California Univ., Los Angeles. Dept. of Chemistry). 1973. 12p. Dep. NTIS $3.00.

From meeting of the American Physical Society; San Diego, California, USA (19 Mar 1973).

The detection by Raman spectroscopy of the five optical lattice modes of crystalline polymethylenes—that is, of crystalline polyethylene and two long n-alkanes, n-$C_{23}H_{48}$ and n-$C_{44}H_{90}$, is described. Also described are measurements of the pressure and temperature dependences of the energies of these vibrational

modes. Two of the lattice modes were detected in spectra of $n\text{-}C_{44}H_{90}$, and four modes were observed in spectra of $n\text{-}C_{23}H_{48}$. Only a totally symmetric rotary mode was observed for both n-paraffins, and only this mode appeared at all pressures studied (between 1 bar and 40 kbar). No lattice mode is observed in the spectra of polyethylene. (MCW)

23924 (CONF-730613-5) FACTORS AFFECTING PLANT UPTAKE AND DISTRIBUTION OF CADMIUM IN PLANTS. Francis, C. W.; Rush, S. G. (Oak Ridge National Lab., Tenn.). 1973. 18p. Dep. NTIS $3.00.

From 7th annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973).

23925 (CONF-730638-1) COMPETITIVE HYDRATION AND ASSOCIATION IN HYDROUS MOLTEN SALTS. Braunstein, J.; Braunstein, H.; Hardesty, P. T. (Oak Ridge National Lab., Tenn.). 1973. 10p. Dep. NTIS $3.00.

From 15th international conference on coordination chemistry; Moscow, USSR (28 Jun 1973).

The enthalpy of vaporization of water from concentrated aqueous electrolytes is shown to increase rapidly when the water mole ratio content drops below 4 to 8. Equilibrium constants are given for the association of Cd^{2+} and Br^- and the hydration of Cd^{2+} in $CaNO_3 \cdot H_2O$ and other salts. The quasi-lattice model of competing hydration and association equilibria is shown to apply in, but not outside, the Henry's Law range. (DLC)

23926 (CONF-730656-1) RESPONSE OF MAMMALIAN CELLS TO FREEZING AND THAWING. Mazur, P.; Leibo, S. P. (Oak Ridge National Lab., Tenn.). [nd]. 17p. Dep. NTIS $3.00.

From international conference on the cryopreservation of normal and neoplastic cells; Villejuif, France (20 Jun 1973).

23927 (CONF-730709-1) CREATION OF EXCITED STATES AS THE RESULT OF X-RAY PHOTOIONIZATION. Carlson, T. A. (Oak Ridge National Lab., Tenn.). 1973. 29p. Dep. NTIS $3.50.

From eighth international conference on the physics of electronic and atomic collisions; Belgrade, Yugoslavia (16 Jul 1973).

23928 (CONF-730821-1) MAGNETIC MOMENT DISTRIBUTION AROUND Fe IMPURITIES IN Ni_3Ga. Cable, J. W.; Child, H. R. (Oak Ridge National Lab., Tenn.). 1973. 4p. Dept. NTIS $3.00.

From international conference on magnetism; Moscow, USSR (22 Aug 1973).

The spatial distribution of the magnetization around Fe impurities in Ni_3Ga compounds of different host matrix susceptibility were determined from neutron diffuse-scattering measurements. These were made for polycrystalline samples containing 75 and 75.5 at.% Ni with 0.1 at.% Fe impurities. The host matrix susceptibility of the 75.5% compound is twice that of the stoichiometric compound because of a rapid susceptibility divergence near the critical concentration of 75.8 at.% Ni. According to the electron-gas model, this corresponds to an increased exchange-enhancement factor and should lead to an impurity-induced magnetization larger in both magnitude and spatial extent for the 75.5% compound. This is not observed. The magnetic impurity cross sections for the two compounds are the same within experimental error and correspond to moment disturbances of about 33 μ_B/Fe atom extending approximately 15 Å from the impurity sites. This casts serious doubt on the interpretation of the observed susceptibility divergence in terms of an exchange-enhanced itinerant-electron model. (auth)

23929 (CONF-730821-2) EQUATION OF STATE FOR THE HEISENBERG MODEL NEAR T_C. Gonzalo, J. A. (Puerto Rico Nuclear Center, Mayaguez; Puerto Rico Univ., Mayaguez). 1972. 4p. Dep. NTIS $3.00.

From international conference on magnetism; Moscow, USSR (22 Aug 1973).

It is shown in the paper that a rigorous equation of state can be derived, in terms of scaled variables and critical exponents, which appears to be in excellent agreement with numerical results and with available experimental data. (JRD)

23930 (CONF-730901-2) HEAT CAPACITY OF LIQUID BISMUTH. Brooks, C. R. (Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering). 1973. Contract AT(40-1)-3291. 5p. Dep. NTIS $3.00.

From 3rd international conference on chemical thermodynamics; Baden, Austria (3 Sep 1973).

The heat capacity at constant pressure C_p of liquid bismuth has been measured from the melting point to about 770°K using adiabatic calorimetry (with an error of about ±1 %). The heat capacity decreased by about 5% over this temperature range. The heat capacity at constant volume C_v was calculated by applying the dilation correction, and C_v has essentially the same temperature dependence as does C_p. (auth)

23931 (CONF-730916-3) CREEP PROPERTIES OF A TYPE 308 STAINLESS STEEL PRESSURE VESSEL WELD WITH CONTROLLED RESIDUAL ELEMENTS. King, R. T.; Stiegler, J. O.; Goodwin, G. M. (Oak Ridge National Lab., Tenn.). 3 Jan 1972. 39p. Dep. NTIS $4.00.

From international conference on creep and fatigue in elevated temperature applications; Philadelphia, USA (23 Sep 1973).

Creep properties of SMA (shielded metal arc) type 308 stainless steel weld metal with CRE (controlled residual elements) boron (0.007%), titanium (0.06%), and phosphorus (0.04%) were studied at 482 to 650°C. Improved ductility compared with that of standard welds in tests lasting several thousands of hours is associated with the absence of interphase separation. Systematic variations of microstructure and creep properties through the weld and in the heat-affected zone are due to thermal and mechanical cycling during the welding process. Anisotropic deformation related to local substructure and preferred crystallographic orientation occurs. Creep strengths are acceptable by present design rules. (auth)

23932 (COO-1105-195) BILINEAR DYNAMICS OF A CaF_2 ELECTRET. Podgorsak, E. B.; Moran, P. R. (Wisconsin Univ., Madison). 1972. 10p. Dep. NTIS $3.00.

The measured strong space-charge electret equilibrium polarization in high-purity CaF_2 follows the form predicted for stored charge in a Schottky barrier. The electret decay obeys simple bilinear dynamics with a thermally activated rate constant. The formation of the electret as well as its decay is directly governed by the sample's bulk ionic conductivity. (auth)

23933 (COO-1105-197) BILINEAR TRANSIENT RESPONSE, IONIC SCHOTTKY VOLTAGE RESPONSE, TEMPERATURE PROGRAMMABLE CAPACITOR ELEMENT. Moran, P. R.; Podgorsak, E. B. (Wisconsin Univ., Madison). 1973. 13p. Dep. NTIS $3.00.

A new electret-related capacitor device is described. The capacitor charge obeys bilinear, rather than linear, dynamics; Schottky barrier equilibrium, rather than linear equilibrium; and exhibits a strength 10^2 larger than ordinary geometrical capacitance. These strange properties, moreover, can be temperature-programmed, and many useful new devices easily constructed. (auth)

23934 (COO-1222-56) STERIC EXCLUSION BEHAVIOR OF SODIUM DODECYL SULFATE AT PRESSURES UP TO 50,000 PSI. Maldacker, T. A.; Rogers, L. B. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). 1972. Contract AT(11-1)-1222. 34p. Dep. NTIS $3.75.

The monomer–micelle equilibrium of sodium dodecyl sulfate (SDS) has been examined by steric exclusion chromatography as a function of pressure. Results of the high-pressure chromatography of micelles were compared to high-pressure spectroscopy of inorganic complex ions and ultracentrifugation of proteins. High-pressure chromatography up to 20,000 psi was done using Sephadex G-10 and G-25. Bed compression was minimal, and reproducible retention volumes using carbowax 20M and ethylene glycol were obtained. (DLC)

23935 (COO-1222-58) ANION EXCHANGE BEHAVIOR OF BROMIDE, CHLORIDE, NITRITE, AND THE LEAD(II)–NITRATE SYSTEM AT PRESSURES UP TO 3600 kg/cm^2. Maldacker, T. A.; Rogers, L. B. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). 1971. Contract AT(11-1)-1222. 12p. Dep. NTIS $3.00.

Retention volumes of Br^-, Cl^-, and NO_3^- were found to increase with pressure. The retention volume of the Pb(II) nitrate species was found to decrease significantly with pressure. (DLC)

23936 (COO-1248-37) PORTABLE ELECTRICAL AEROSOL ANALYZER FOR SIZE DISTRIBUTION MEASUREMENT OF SUBMICRON AEROSOLS. Liu, B. Y. H.; Whitby, K. T.; Pui, D. Y. H. (Minnesota Univ., Minneapolis. Particle Technology Lab.). 1972. 31p. (CONF-730612-2). Dep. NTIS $3.75.

From 66th annual meeting of the Air Pollution Control Association; Chicago, Illinois, USA (24 Jun 1973).

23937 (COO-1332-81) DESIGN AND TESTING OF A HEAT TRANSFER MODEL OF A RACCOON (PROCYON LOTOR) IN A CLOSED TREE DEN. Thorkelson, J.; Maxwell, R. K. (Minnesota Univ., St. Paul (USA). Dept. of Ecology and Behavioral Biology). 1972. 32p. Dep. NTIS $3.75.

23938 (COO-1332-92) BREEDING BEHAVIOR OF CAPTIVE MALLARDS. Barrett, J. (Minnesota Univ., St. Paul (USA). Dept. of Ecology and Behavioral Biology). Jun 1973. Contract AT(11-1)-1332. 83p. Dep. NTIS $6.25.

Thesis.

23939 (COO-2002-21) SIMPLE BIOASSAY FOR DETRITAL CONSUMER ACTIVITY IN STREAMS. Cummins, K. W. (Michi-

gan State Univ., East Lansing). 1973. Contract AT(11-1)-2002. 16p. Dep. NTIS $3.00.

23940 (COO-2114-6) QUALITY CIRCUIT BOARD ETCHING AT LOW COST. Mugge, M. (Colorado Univ., Boulder (USA). Duane Physical Lab.). [nd]. 7p. Dep. NTIS $3.00.

23941 (COO-2122-11) ANAKTUVUK PASS, ALASKA VILLAGE CENSUS. Hanson, W. C. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). Sep 1972. Contract AT(11-1)-2122. 36p. Dep. NTIS $4.00.

This census represents an updating of a similar census conducted during November, 1969, and issued as BNWL-1242. The prime reason for the initial census was to serve as a guide for use in radiation ecology studies that involved whole-body counting of Anaktuvuk Pass residents, where age was an important consideration. (LMT)

23942 (COO-2271-13) REARRANGEMENT INEQUALITY ON A CIRCULAR DOMAIN. Friedberg, R.; Luttinger, J. M. (Columbia Univ., New York. Dept. of Physics; Barnard Coll., New York. 1973. 20p. Dep. NTIS $3.00.

A rearrangement inequality for multiple integrals on a circular domain is stated and proved. Its relation to a previous theorem for functions on the real line is discussed. (auth)

23943 (COO-3012-26) TUMOR THERAPY WITH RADIOLABELED HETEROLOGOUS ANTIBODY. Ninth Annual Report. Reif, A. E. (Boston City Hospital, Mass.). 15 Jul 1973. Contract AT(11-1)-3012. 6p. Dep. NTIS $3.00.

23944 (COO-3012-27) TUMOR THERAPY WITH RADIOLABELED HETEROLOGOUS ANTIBODY. 9-Year Summary Report. Reif, A. E. (Boston City Hospital, Mass.). 15 Jul 1973. Contract AT(11-1)-3012. 24p. Dep. NTIS $3.25.

23945 (COO-3029-8) INTERACTION OF COLLOIDAL PARTICLES WITH SURFACES OF BIOLOGICAL SIGNIFICANCE. Turkevich, J.; Demirci, S.; Skvir, D. J. (Princeton Univ., N. J. Dept. of Chemistry). 1971. 19p. Dep. NTIS $3.00.

The adhesion of colloidal gold on membranes was examined with an electron microscope with protein on the membrane, on the colloidal particles, and present on both membrane and particles. The conditions for best adhesion were determined. Quantitative measurements were carried out using adhesion to the membrane to monitor diffusion, centrifugation, and electrophoresis of colloidal particles. Electrophoresis in a centrifugal field was used as a null method to determine the charge on the colloidal particle.

23946 (COO-3084-18) CONTINUUM PLASTICITY IN RELATION TO MICROSCALE DEFORMATION MECHANISMS. Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). Jan 1973. Contract AT(11-1)-3084. 15p. (CONF-730210-3). Dep. NTIS $3.00.

From symposium on metallurgical effects at high strain rates; Albuquerque, New Mexico, USA (5 Feb 1973).

In principle, constitutive laws for continuum plasticity are derivable from quantitative descriptions of deformation mechanisms such as dislocation motion, operative on the microscale. Progress on rigorous approaches to this micro–macro transition problem is reviewed. A general thermodynamic framework is established by which the macroscopic plastic strain tensor is related to corresponding structural rearrangements, such as slip, taking place locally on the microscale of a heterogeneous sample of material (e.g., a polycrystal). Kinetic relations governing the rates of these rearrangements are then considered, together with second-law restrictions upon them. Finally, some attempts at specific predictions of the macroscopic behavior of polycrystals are reviewed. These range from detailed "self-consistent model" calculations to simpler approaches which are merely motivated by microscale considerations. (JRD)

23947 (COO-3084-19) ELASTIC POTENTIALS AND THE STRUCTURE OF INELASTIC CONSTITUTIVE LAWS. Hill R.; Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). Feb 1973. Contract AT(11-1)-3084. 26p. Dep. NTIS $3.50.

The existence of a work potential, governing material response when elastic behavior occurs, is shown to provide a concise framework for the structure of inelastic constitutive laws. The discussion includes the identification of differential invariants in conjugate stress and strain variables, an examination and reformulation of postulates leading to "normality rules", and a study of the transmission of constitutive properties from subelements to overall behavior of heterogeneous systems. Also, internal variable representations of inelasticity are examined within this framework. (auth)

23948 (COO-3084-20) RELATIONSHIP BETWEEN CRITICAL TENSILE STRESS AND FRACTURE TOUGHNESS IN MILD STEEL. Ritchie, R. O.; Knott, J. F.; Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). Mar 1973. Contract AT(11-1)-3084. 29p. Dep. NTIS $3.50.

An analysis is presented which relates the critical value of tensile stress (σ_ξ) for unstable cleavage fracture to the fracture toughness (K_{Ic}) for a high-nitrogen mild steel under plane strain conditions. Unstable fracture is found to be consistent with the attainment of a stress intensification close to the tip such that the maximum principal stress σ_{yy} exceeds σ_ξ over a characteristic distance, determined as twice the grain size. Results of the analysis are used to predict the experimentally determined variation of K_{Ic} with temperature over the range −150 to −75°C from a knowledge of the yield stress and hardening properties. It is further shown that the onset of fibrous fracture ahead of the tip can be deduced from the position of the maximum achievable stress intensification. The relationship between the model for fracture ahead of a sharp crack, and that ahead of a rounded notch is discussed in detail. (auth)

23949 (COO-3084-21) SHAPE OF INTERGRANULAR CREEP CRACKS GROWING BY SURFACE DIFFUSION. Chuang, T. J.; Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). Apr 1973. Contract AT(11-1)-3084. 14p. Dep. NTIS $3.00.

A crack-like creep rupture cavity is considered to extend along the interface between two grains by diffusive transport of material into the boundary ahead of its tip. The shape of the cavity surfaces is determined on the assumptions that this is governed by surface diffusion, and that steady-state conditions prevail, so that the cavity advances as a profile retaining a constant shape near its tip. A second-order nonlinear differential equation for the profile is derived and a simple approximate solution is given, which is shown to be highly accurate by comparison to a numerical solution. This allows the crack velocity, the radius of curvature adjacent to the tip, and the rate of matter flux into the boundary ahead of the tip to be related to one another and to material constants. (auth)

23950 (COO-3084-23) DETERMINATION OF ELASTODYNAMIC CRACK TIP STRESS FIELDS. Freund, L. B.; Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). May 1973. Contract AT(11-1)-3084. 15p. Dep. NTIS $3.00.

A linear elastic body in plane strain which contains a stationary crack and which is initially at rest and stress free is considered. It is shown that if the elastodynamic displacement field and stress intensity factor are known, as functions of crack length, for any symmetrical distribution of time-varying forces which acts on the body, subsequent to $t = 0$, then the stress intensity factor due to any other symmetrical load system whatsoever which acts on the same body may be directly determined. The other load system may be of arbitrary spatial distribution and time variation. Further, that part of the elastodynamic displacement field due to the other load system, which arises from the presence of the crack, may also be directly determined. The results are obtained by extension of Rice's mode of derivation of the corresponding Bueckner–Rice elastostatic results to Laplace-transformed elastodynamic variables. Likewise, the existence of a universal elastodynamic "weight function" for any given cracked body is demonstrated. As an application, Freund's recent result for the stress intensity factor due to suddenly applied concentrated forces on the crack surfaces is derived directly by our method, from de Hoop's earlier solution for suddenly applied uniform pressures. (auth)

23951 (COO-3085-23) EFFECTS OF HORMONES ON DEVELOPMENT OF FETAL ENZYMES. Greengard, O. (Harvard Medical School, Boston, Mass.; New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). 1973. Contract AT(11-1)-3085. 15p. Dep. NTIS $3.00.

This study was concentrated on development of enzyme systems in rat liver during late fetal and neonatal life; this was combined with the morphometry of cell types and of subcellular organelles. A cluster of enzymes that emerge during late fetal life and attain their adult concentrations at term was distinguished from another cluster that makes its appearance immediately after birth. Different hormones (e.g., thyroxine, glucagon and glucocorticoids), the secretion of which is the natural stimulus for the expression of specific groups of genes, were identified. With the administration of these hormones to fetuses it is possible to evoke the synthesis of chosen enzymes before the scheduled time and to produce newborns (delivered at term or prematurely) with precociously mature enzyme profiles (LMT)

23952 (COO-3140-12) TOXICOLOGY AND METABOLISM OF NICKEL COMPOUNDS. Progress Report, December 1, 1972–November 30, 1973. Sunderman, F. W. Jr. (Connecticut Univ., Farmington (USA). School of Medicine). [nd]. Contract AT(11-1)-3140. 15p. Dep. NTIS $3.00.

23953 (COO-3151-24) FAR-INFRARED SPECTRA BETWEEN 4 AND 200 cm^{-1} OF POLY-L-ALANINE. Shotts, W. J.; Sievers,

A. J. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). May 1973. 12p. Dep. NTIS $3.00.

23954 (COO-3259-29) TRANSPORT AND MAGNETIC PHENOMENA IN CHROMIUM AND IRON ALLOYS (IV). Final Report, March 4, 1969–June 30, 1973. Arajs, S. (Clarkson Coll. of Tech., Potsdam, N. Y.). 1973. Contract AT(11-1)-3259. 13p. Dep. NTIS $3.00.

The electrical resistivity, thermoelectric power, thermal conductivity, and magnetization of different binary chromium and iron alloys over large temperature ranges (4 to 1700°K) were investigated from the viewpoint of their electronic structures and the interactions among elementary excitations in magnetically ordered metallic systems. Although iron and chromium base alloys are technologically important materials, their physical nature is only partially understood. The investigation was directed towards a better understanding of these important metallic systems from a fundamental point of view. (auth)

23955 (COO-3326-21) PHOTOCHEMISTRY AND ENZYMOLOGY OF PHOTOSYNTHESIS. Progress Report, August 1, 1972–July 31, 1973. Kok, B. (Martin Marietta Labs., Baltimore, MD. (USA)). 1973. Contract AT(11-1)-3326. 17p. Dep. NTIS $3.00.

23956 (COO-3400-17) COMPUTER-ASSISTED MODELING OF THE CALCIUM SYSTEM: KINETICS OF GASTROINTESTINAL CALCIUM TRANSPORT. Ramberg, C. F. Jr. (Pennsylvania Univ., Kennett Square. School of Veterinary Medicine). 1972. 9p. (CONF-720733-3). Dep. NTIS $3.00.

From production disease conference; Reading, UK (Jul 1972).

Results obtained during the initial phases in the development of a model of gastrointestinal calcium transport in cattle are presented. The experiments involved simultaneous oral and intravenous administration of two calcium tracers, and derivation of an input function describing the rate of entry or radiocalcium from the gut. The nature of the input function differed markedly between a mature cow and a young calf, reflective of the stage of rumen development. The area under the input function decreased curvilinearly with increasing dietary calcium intake, suggestive of a saturable mechanism for calcium absorption in mature cattle. (auth)

23957 (COO-3400-18) LACK OF DIETARY FAT RELATIVE TO GLUCOSE PRECURSORS MAY CAUSE KETOSIS OR DEPRESS MILK FAT CONTENT. Kronfeld, D. S. (Pennsylvania Univ., Kennet Square. School of Veterinary Medicine). 1972. 3p. (CONF-720733-2). Dep. NTIS $3.00.

From production disease conference; Reading, UK (Jul 1972).

23958 (COO-3469-5) COMPLEXING OF Ca(II), Co(II), AND Zn(II) BY POLYMETHACRYLIC AND POLYACRYLIC ACID. Travers, C.; Marinsky, J. A. (State Univ. of New York, Buffalo. Dept. of Chemistry). 1973. Contract AT(11-1)3469. 27p. Dep. NTIS $3.50.

A potentiometric method for the estimate of the nonideal behavior of metal ions in the course of their complexation by polyacids was used to show that the dominant complex species in Ca(II)-, Co(II)-, and Zn(II)-polymethacrylic and polyacrylic acids is an ion pair. The formation constants of the ion pair species were also determined. (DLC)

23959 (COO-3474-2) CYCLING AND EFFECTS OF ^{36}Cl LABELED DDT ON SOIL INVERTEBRATES. Annual Progress Report, 1972–1973. Dindal, D. L. (State Univ. of New York, Syracuse (USA). Coll. of Environmental Science and Forestry). [nd]. Contract AT(11-1)-3474. 6p. Dep. NTIS $5.00.

23960 (DP-MS-72-70) ACCELERATED EVOLUTION OF HYDROGEN FROM METALS DURING PLASTIC DEFORMATION. Donovan, J. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 1972. 34p. (CONF-730554-1). Dep. NTIS $3.75.

From meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Philadelphia, Pennsylvania, USA (29 May 1973).

Plastic deformation accelerates the release of hydrogen from iron, 304L stainless steel, nickel, Inconel 718, and 5086 aluminium. The release rate is strain dependent: it increases rapidly when plastic deformation begins, reaches a maximum, and then decreases with additional strain with a final large release at fracture. The release rate is constant during Luder's extension for iron, and fluctuates coincidentally with the serrated flow of 5086 aluminum. The release rate during deformation also depends on temperature and strain rate. The accelerated release rates during deformation are discussed in terms of hydrogen-dislocation interactions and are interpreted to be caused by the egress of dislocations and their associated hydrogen atmospheres during plastic deformation. (auth)

23961 (EDFB-IBP-73-7) MODELING FOREST ECOSYSTEMS. Report of International Woodlands Workshop, International Biological Program/PT Section, August 14–26, 1972. Kern, L. (ed.). (Oak Ridge National Lab., Tenn.). Aug 1973. 343p. (CONF-720859). Dep. NTIS $10.60.

23962 (FMI-1000-427) FLUORESCENT THYROID SCANNING: WHAT'S NEW? Beck, R. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1971. 12p. (CONF-730321-2). Dep. NTIS $3.00.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

23963 (FMI-1000-443) HL-A ANTIGENS AND HODGKIN'S DISEASE. II. Report on the Histological Analysis. Chelloul, N.; Burke, J.; Motteram, R.; le Capon, J.; Rappaport, H. [nd]. 9p. (CONF-720593-1). Dep. NTIS $3.00.

From international conference on histocompatibility; Evian, France (May 1972).

23964 (GEPP-109) ADHESION AND CLEANING STUDY. Creed, K. E. Jr. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). 1 Aug 1973. Contract AT(29-2)-656. 22p. (CONF-730455-1). Dep. NTIS $3.25.

From adhesive conference for integrated contractors; Oak Ridge, Tennessee, USA (25 Apr 1973).

Materials and techniques for the adhesion and cleaning of dissimilar materials were evaluated. Materials studied were of grossly different coefficients of expansion, surface texture, energy and chemical make-up. Standard methods and materials for cleaning and surface preparation were used. (auth)

23965 (INP-825) ALGOL 1204 PROGRAM FOR THE REFINEMENT OF CRYSTALLOCHEMICAL STRUCTURE FROM NEUTRON POWDER-DIFFRACTION DATA. Tomkowicz, Z. (Institute of Nuclear Physics, Krakow (Poland)). Jan 1973. 15p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.00.

An Algol 1204 program is presented for the refinement of crystallochemical structure from neutron powder-diffraction patterns by the least-squares method. The full matrix of the normal equations system is taken into account. The program can be used for all crystallographic systems. The subject of the refinements are free parameters X_j of the space group, occupation numbers n_j, and temperature factors B_{oj}. (auth)

23966 (IS-3133) EFFECTS OF CRYSTALLOGRAPHIC ANISOTROPY ON THE GROWTH RATES OF WIDMANSTATTEN PRECIPITATES FORMED DURING SOLID–SOLID PHASE TRANSFORMATIONS. Bosze, W. P. (Ames Lab., Iowa). Aug 1973. Contract W-7405-eng-82. 167p. Dep. NTIS $10.50.

Thesis.

A theoretical model is developed that includes crystallographic considerations insofar as they introduce anisotropy in the phenomenological interface kinetic coefficient, $\mu_{(\theta)}$. Anisotropy in interface energy can parallel the mathematical development. Under the phenomena, Widmanstätten precipitates will lengthen fastest in the direction where $\mu_{(\theta)}$ is greatest. The fastest lengthening plates $\mu_{(\theta)}$ will decrease along the interface away from the growth direction. It is found for hypereutectoid Widmanstätten cementite that the empirical lengthening rates can be accounted for by plate growth provided the anisotropy is at least as large, but opposite in sign, as the combined isotropic interface kinetic and capillarity effects. (37 references) (MCW)

23967 (IS-T-582) DENSITIES, MICROSTRUCTURES, AND HARDNESS OF AS-QUENCHED HIGH-PURITY IRON–CARBON ALLOYS. Litwinchuk, A. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 45p. Dep. NTIS $4.25.

Thesis.

A curve showing the hydrostatic density of as-quenched iron–carbon alloys as a function of carbon content was experimentally determined. The density decreases with an increase in carbon content until a minimum is reached at 1.15 wt. % carbon. Further increases in carbon content cause an increase in the density, which is due to retained austenite. The difference in density between the values calculated using x-ray lattice parameters and the hydrostatically determined value is pointed out. The hardness values of as-quenched iron–carbon alloys were determined using Vickers hardness numbers and Rockwell "C". Both tests show an increase in hardness with increasing carbon content to a maximum value at about 1.0 wt. % carbon. Upon increasing the carbon content, the hardness decreases due to increasing amounts of retained austenite. (auth)

23968 (IS-T-586) EVEN-TEMPERED GAUSSIAN ATOMIC ORBITAL BASES IN QUANTUM CHEMISTRY: AB INITIO CALCULATIONS ON ATOMS HYDROGEN THROUGH KRYPTON AND ON MOLECULES CONTAINING CARBON, HYDROGEN, AND

OXYGEN. Bardo, R. D. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 203p. Dep. NTIS $12.25.
Thesis.

Even-tempered atomic orbital bases are formulated which have the property that atomic orbital scaling can be closely simulated through variation of linear expansion coefficients. Bases of even-tempered Gaussian primitives are fully optimized in molecules by minimizing the total molecular energies. Contracted atomic orbitals are constructed from the optimized molecular orbitals of these molecules. Transferability of the optimal, even-tempered primitive and contracted bases between molecules is discussed. The quality of the optimized basis is ascertained by calculations of the theoretical equilibrium geometries and of reaction energies. In order to perform the even-tempered basis and geometry optimizations, minimization schemes are implemented and used in conjunction with the LCAO–MO–SCF method. When these techniques are employed, the amount of work involved in molecular optimizations is greatly reduced. (LMT)

23969 (IS-T-594) REMOVAL OF LEAD FROM LIQUID BISMUTH BY ADSORPTION. Thompson, K. D. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 62p. Dep. NTIS $5.25.
Thesis.

Lead can be removed from liquid bismuth by adsorption on silica gel. (DLC)

23970 (ITF-73-52-P) GENERATION OF SPIN-EXCITATIONS BY ELECTRON BEAM IN FERRO- AND ANTIFERROMAGNETIC DIELECTRICS MODEL WITH POLAR-STATES. Glauberman, A. E.; Katut, F. (Akademiya Nauk Ukrainskoi SSR, Kelv. Institut Teoreticheskoi Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Energy spectra of magnons and magnons with charge transfer are found in a ferrodielectric model with polar states. The expressions for probability of generation of these elementary excitations by electron beams are considered in a charge-carrier weak dispersion approximation. The additional splitting of the magnon spectrum, depending on the polar-excitation concentration, is found in the simplified model of an antiferromagnetic dielectric. (19 references) (auth)

23971 (ITF-73-58-E) CAUCHY PROBLEM FOR THE KINETIC BOGOLYUBOV EQUATIONS. Petrina, D. Ya.; Vidybida, O. K. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The kinetic Bogolyubov equations for classical statistics are investigated. The Cauchy problem in the Banach space of the integrable-function sequences is solved by the semigroup method. A compact formula for the solution is derived. (tr-auth)

23972 (JEN-251) IONIC PROPULSION. Velarde, G. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 44p. (In Spanish). Dep. NTIS (U. S. Sales Only) $4.25.

The inner parameters (electrons and ions velocity, current, thrust, power; specific impulse, ...) and the outer parameters (velocity and operating time) of an ion propellant rocket are studied. The components (chamber dimensions, weights, propellants, ...) are also described. (auth)

23973 (JINR-E14-7093) QUASIELASTIC NEUTRON SCATTERING BY LOW-TEMPERATURE PLASTIC PHASE OF t-BUTYL CHLORIDE. Goyal, P. S.; Nawrocik, W.; Urban, S.; Domoslawski, J.; Natkaniec, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

Cold-neutron scattering by t-butyl chloride in one of its solid phases is presented. The quasielastic spectra are compared with Sköld's model of molecular reorientations. The average time between successive reorientations is of the order of 12×10^{-12} sec. The activation energy was estimated. (auth)

23974 (JINR-P4-7141) ABSENCE OF PHASE TRANSITION IN ONE-DIMENSIONAL SYSTEM OF STRONGLY CORRELATING ELECTRONS. El'k, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The phase diagram of strongly correlating electrons is considered, based on numerical data on heat capacity and magnetic susceptibility. (tr-auth)

23975 (JINR-P4-7145) MAGNETIC EXCITATIONS IN ANHARMONIC FERROMAGNETIC CRYSTAL. Konvent, G.; Plakida, N. M.; Vukailovich, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The energy spectrum of magnetic excitations in the Heisenberg model of an anharmonic ferromagnet is considered, with account of spin–phonon interactions of all orders in the atomic displacements. An exact representation for the self-energy operator of the two-time Green function for the transverse spin components is obtained and an approximate expression for it is given in the second order of renormalized spin–spin and spin–phonon interactions. (20 references) (auth)

23976 (JPRS-59393) APPLICATION OF DYNAMIC NUCLEAR POLARIZATION TO INCREASE THE SENSITIVITY AND SPEED OF NUCLEAR PRECESSION MAGNETOMETERS. Skrotskii, G. V.; Stepanov, A. P.; Stotskii, V. M.; Filatov, A. I. Translated from Geofiz. App.; No. 42, 10-57(1970). 50p. NTIS.

A discussion is given of nuclear precession magnetometers for measurements on the ground, in outer space, and in water. Evaluation of these magnetometers over other types is given. Solution of geological problems is also presented. (13 figures, 55 references) (auth)

23977 (JUL-913-FF) INFLUENCE OF NONMAGNETIC FAULTS ON THE KONDO EFFECT. Bohnen, K. P. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Dec 1972. 120p. (In German). Dep. NTIS (U. S. Sales Only) $8.00.
Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The problem was considered within the framework of the s–d model, where exchange-interaction effects between magnetic defects were neglected (i.e., only systems with a small concentration were treated). The full T-matrix for the system with magnetic defects is given. Nonmagnetic defects influence the T-matrix in two ways: they change the Kondo temperature and effect additional factors which only depend on nonmagnetic defects. The results of electron-irradiated Cu–Mn are compared with the mode for pairs consisting of magnetic and nonmagnetic defects. In addition, the influence of statistically distributed nonmagnetic defects on electrical resistance was investigated; at small concentrations there is a linear relationship, and the Kondo temperature changes accordingly. The theoretically developed concepts are compared with the results with layers condensed by quenching. (39 references (GE)

23978 (KFK-1731-UF) EXTRACTION OF HUMIC ACID FROM WATER WITH TRIOCTYLAMINE. Eberle, S. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Apr 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

It was found that humic acid forms with trioctylamine a salt that is easily soluble in aromatic and chlorinated hydrocarbons. The acid can be extracted from aqueous solutions by solutions of the amine in one of these solvents. Using 10 vol. % trioctylamine in chloroform, the acid is extracted from water below pH = 5 with a partition coefficient of >100 and is backextracted quantitatively above pH 9. By this, a new method is given for the selective separation of humic acid. Humic acid was separated from water of a moor of the Black Forest ("Hohlohsee"), the yield was 10 mg/l water. An analytic procedure for the extractive-spectrophotometric determination of humic acid in water is given. Ligninsulfonic acid behaves like humic acid with respect to the extraction by TOA. Both acids may be determined simultaneously by calculating their concentrations from the absorbance measured at two wavelengths. (auth)

23979 (KFKI-73-20) DETERMINATION OF METALS OF LOW CONCENTRATION IN HIGH-PURITY COPPER BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Balla, K. Z.; Harsanyi, E. G.; Polos, L.; Pungor, E. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). May 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Analyses of binary copper alloys were carried out by the atomic absorption method. The metal components were cadmium, cobalt, iron, gallium, germanium, and tin, in concentration range from 10 to 20000 ppM. Optimum analytical conditions and interference of matrix elements for each composition were determined. Preparation of the samples, sensitivity, detection limit, and standard deviation of the method are given. Results are compared with those obtained by polarography, spectrophotometry, and spectrography. (auth)

23980 (KFKI-73-32) ELECTRIC-FIELD-INDUCED INSTABILITIES IN NEMATIC LIQUID CRYSTALS. Bata, L.; Buka, A.; Janossy, I. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

Instabilities arising when a static or alternating electric field is applied to a nematic liquid crystal cell are discussed. The threshold voltage for inducing instability is presented as

a function of the frequency. Regular structures observed at static and alternating fields are described in detail. Some observations associated with development of turbulence are also reported. (auth)

23981 (LA-5265-T) REACTIONS OF N_2F_4 AND SF_6 WITH H_2 INDUCED BY CO_2 LASER PULSES AND BY ELECTRICAL DISCHARGE. Lyman, J. L. (Los Alamos Scientific Lab., N. Mex.). Jul 1973. Contract W-7405-eng-36. 181p. Dep. NTIS $7.60.

Thesis. Submitted to Brigham Young Univ., Provo, Utah.

23982 (LA-5297-MS) COMPARATIVE EVALUATION OF SEVERAL GLASS-FIBER FILTER MEDIA. Stafford, R. G. (Los Alamos Scientific Lab., N. Mex.). Jun 1973. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Several types of glass-fiber filter media were evaluated at Los Alamos Scientific Laboratory (LASL) for DOP smoke penetration and filter pressure drop. The results were compared to previous MIL-F-51079 specification tests performed at the Naval Research Laboratory (NRL) on the same media. In most cases, LASL DOP smoke penetration and pressure drop were lower than that reported by NRL. Density corrections were found to be valid experimentally at velocities below 25 cm/sec and application of these corrections lead to better agreement between the two laboratories; however, results are not entirely consistent. All media tested by LASL met the MIL-F-51079 specifications for the two parameters evaluated. (auth)

23983 (LA-5308-PR) DEVELOPMENT OF AIR SAMPLING TECHNIQUES. LASL Project R-059. Quarterly Report, January 1 – March 31, 1973. (Los Alamos Scientific Lab., N. Mex.). Jun 1973. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Breakthrough and desorption studies were done for o-toluidine, N,N-dimethylaniline, o-anisidine, o-chloroaniline, and mixed xylidines using the proposed sampling and analytical method for aniline. These compounds were adequately absorbed and retained on silica gel for an 8-h sampling period. (auth)

23984 (LA-tr-73-22) PREPARATION OF STABLY LABELED (^{15}N, ^{13}C, ^{2}H) NATURAL PRODUCTS WITH THE AID OF AUTOTROPHIC ALGAE CULTURES AND RECENT APPLICATIONS OF STABLE ISOTOPES IN THE BIOSCIENCES. Jung, G.; Juttner, F. Translated from Chem. Ztg.; 96: 603-611(1972). 28p. Dep. NTIS $3.50.

The development of sensitive instruments for routine analysis of stable isotopes (mass spectrometer coupled with gas chromatograph emission spectrometer for ^{15}N, infrared spectrometer, pulsed-Fourier-transform nuclear magnetic resonance spectrometer) opens new and broad fields in the application of stable isotopes in all biosciences and in chemistry, particularly for ^{13}C, ^{15}N, ^{2}H, and ^{18}O. Stably labeled organic basic compounds of metabolism are prepared to advantage with the aid of autotrophic algae cultures with selected species of green and blue algae. Optimal use of ^{15}N-nitrate, ^{13}C carbon dioxide, ^{2}H and ^{18}O water given to the growing algae is achieved in fully automated large-scale cultivation apparatus and by optimized separation procedures of the algae hydrolysates yielding stable labeled natural products. Selected examples of recent applications of compounds labeled with stable isotopes are discussed. (auth)

23985 (LA-tr-73-28) MECHANICS OF SLIDING OF HOT, VISCOUS GLASS ON METAL SURFACES. Trier, W.; Hassoun, F. Translated from Glastech. Ber.; 45: 271-276(1972). 20p. Dep. NTIS $3.00.

The sliding behavior of hot viscous lime soda glass on a metal surface was experimentally investigated by means of a metal channel that could be heated. The variables consisted of the falling speed of the glass globule, the glass temperature, the temperature of the channel and the surface roughness of the metal. In addition, different lubricants were tested. The average sliding velocity, the energy loss in the channel and the electrical contact resistance were measured. The glass–metal coefficient of friction was determined by means of these data. The results show that surface condition and metal temperature exert a strong influence on the process of sliding. Whereas the coefficient of friction in a rough channel decreased with temperature, a smooth channel resulted in an increase. Lubricants do not always decrease the coefficient of friction. Bearing pressure increases the coefficient of friction. (auth)

23986 (LA-tr-73-37) EXISTENCE OF A THIRD CHAIN EXPLOSION LIMIT IN THE OXYGEN-INHIBITED $H_2 + F_2$ MIXTURE. Tal'roze, V. L. 1969. Translated by Helen J. Dahlby (Los Alamos Scientific Lab., NM) from pp 165-170 of Svobodnoradikal'nye Sostoianiia Khimiia. 13p. Dep. NTIS $3.00.

23987 (LB-1474) INVESTIGATION OF METALLURGICAL FACTORS WHICH AFFECT THE FRACTURE TOUGHNESS OF ULTRAHIGH-STRENGTH STEELS. Wood, W. E.; Parker, E. R.; Zackay, V. F. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 208p. Dep. NTIS $12.50.

The relationship between microstructure, heat treatment, and room temperature fracture toughness was determined for the low-alloy ultrahigh-strength steels 4130, 4330, 4340, 4140, and 300-M. Optical metallography, microprobe analysis, and scanning electron microscopy were used to characterize the structure and morphology, while both Charpy V-notch impact tests and plane strain fracture toughness tests were used to determine the fracture properties. The normal commercial heat treatment resulted in the formation of some bainite in all the alloys. MnS inclusions on prior austenite grain boundaries were found to initiate cracks during loading. By increasing the austenitizing temperature to 1200°C, the fracture toughness could be increased by at least 60%. For some alloys increasing the severity of the quench in conjunction with the higher austenitizing temperatures resulted in further increases in the fracture toughness, and the elimination of any observable upper bainite. There was no correlation between the Charpy impact test results and the fracture toughness results. The alloys 4130, 4140, 4340 all showed a severe intergranular embrittlement when austenitized at high temperatures and tempered above 200°C, while the alloys 4330 and 300-M exhibited no drop in toughness for the same heat treatment conditions. The as-quenched tensile specimens had a very low "micro" yield strength which rapidly increased to the level of the "macro" yield strength when tempered. (JRD)

23988 (LBL-117) NUCLEAR DOUBLE RESONANCE STUDY OF KH_2PO_4. Nordal, P. E. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 292p. Dep. NTIS $16.75.

Thesis.

NMR pulse methods were used to study NMR/NQR spectra and relaxation phenomena in single crystals of KH_2PO_4 (KDP), elucidating the lattice dynamics at the ferroelectric phase transition via the temperature dependence of the ferroelectric-mode induced spin–lattice relaxation of ^{39}K. ^{39}K spin–lattice relaxation time measurements were performed with a new high-sensitivity nuclear double resonance method that employs an unmodulated radio-frequency (r.f.) field at the "rare spin" frequency. The method yields double resonance lineshapes with structure that depends critically on spin reservoir parameters exhibiting 2 line depth maxima symmetrically located about the line center, with a minimum line depth exactly on resonance. (98 references) (MCW)

23989 (LBL-1413) VISCOSITY OF CESIUM METAL TO ITS CRITICAL TEMPERATURE. Tsai, H. C. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 68p. Dep. NTIS $5.50.

Thesis.

Cesium metal viscosity was measured up to 1600°C by oscillating-cup techniques. Viscous drag due to the saturated vapor phase was taken into account in the data analysis. Equations are given to represent the measured results. The critical viscosity of cesium determined from the law of rectilinear diameters is 0.57 ± .04 millipoise. Viscosities of sodium and potassium were also estimated from the cesium data by the law of corresponding states. (auth)

23990 (LBL-1483) SIMPLE METHOD FOR CHARPY IMPACT TESTING BELOW 6°K. Jin, S.; Horwood, W. A.; Morris, J. W. Jr.; Zackay, V. F. (California Univ., Berkeley. Lawrence Berkeley Lab). Mar 1973. Contract W-7405-eng-48. 16p. (CONF-730805-2). Dep. NTIS $3.00.

A technique for conducting Charpy impact tests at temperatures as low as 5 to 6°K is described. A Charpy V-notch specimen is wrapped in styrofoam and placed inside a thin-walled lucite box. Liquid helium is then transferred to the box system at 2 to 3 psi dewar pressure and a flow rate of approximately 2 liters/minute using a vacuum insulated transfer line. A steady-state temperature of 5 to 6°K is quickly attained and maintained as long as helium transfer is continued. Results of tests comparing the proposed technique with the ASTM standard method at liquid-nitrogen temperature indicate that a reasonably accurate impact energy is obtained. (auth)

23991 (LBL-1484(Rev.)) IRON–NICKEL–TITANIUM ALLOY WITH OUTSTANDING TOUGHNESS AT CRYOGENIC TEMPERATURE. Jin, S.; Morris, J. W. Jr.; Zackay, V. F. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jul 1973. Contract W-7405-eng-48. 18p. (CONF-730805-7). Dep. NTIS $3.00.

From cryogenic engineering conference; Atlanta, Georgia, USA (7 Aug 1973).

Recent research has shown that the alloy Fe–12Ni–0.25Ti may be processed to have an outstanding combination of strength and toughness at cryogenic temperatures. Test results obtained to date with this alloy are presented and compared with data on the properties of two commonly used cryogenic steels. Tensile properties, impact properties, and preliminary results of fracture toughness tests are presented. (auth)

23992 (LBL-1490) DEVELOPMENT OF ECONOMICAL, TOUGH, ULTRAHIGH-STRENGTH Fe–Cr–C STEELS. McMahon, J. A.; Thomas, G. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 10p. (CONF-730806-2). Dep. NTIS $3.00.

The structure and mechanical properties of Fe–Cr–C martensitic steels are examined with the aim of designing low-cost, strong, tough steels through control of microstructure. Chromium is not an effective solid-solution strengthener in ferritic alloy steels, and, because of this, substructural changes due to alloy additions such as C can be more readily correlated with changes in mechanical properties. Furthermore, Cr is relatively inexpensive yet a desirable alloying element, e.g., for hardenability. (auth)

23993 (LBL-1499) STRESS-INDUCED MARTENSITE–AUSTENITE INTERFACE IN Fe–15Ni–15Cr SINGLE CRYSTALS. Stone, G. A.; Thomas, G. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 5p. (CONF-730816-2). Dep. NTIS $3.00.

From EMSA meeting; New Orleans, Louisiana, USA (14 Aug 1973).

A single crystal stressed in the $[2\bar{1}3]\gamma$ direction at 185°K was transformed to 5% α martensite and 2% ϵ martensite by volume. The austenite slip system of maximum shear stress is the $(\bar{1}11)\gamma$ $[01\bar{1}]\gamma$. A two-surface study using the electron and optical microscopes is shown. Measurements of the acicular crystal axis were made from optical micrographs using the trace of an ϵ plate on the $(11\bar{1})\gamma$ plane cutting the $(\bar{1}11)\gamma$ in the $[101]\gamma$ direction as a crystallographic reference. The physical nature of the interface is being revealed with $(01\bar{1})\gamma$ foils. Efforts to image interface dislocations have been unsuccessful to date. It appears clear that the interface between the phases in this alloy is a composite of dislocated austenite and faulted austenite giving rise to hcp reflections. Also the $(110)\alpha$ surface of the crystal is in contact with and parallel to the $(0001)\epsilon$ plane. The large very thin ϵ plates appear to control the size of the acicular α crystals and forces the long axis of the crystals to remain parallel to the austenite slip plane that is the $(\bar{1}11)\gamma$ in this example. (MCW)

23994 (LBL-1804) COHERENT EXCITON MIGRATION: AN EXPERIMENTAL AND THEORETICAL VIEW. Harris, C. B. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 12p. (CONF-730553-1). Dep. NTIS $3.00.

From 6th molecular crystal symposium; Schloss Elmau, German Democratic Republic (20 May 1973).

23995 (LBL-1807) MEASUREMENT OF INTENSITIES OF LOW-ENERGY ELECTRON-DIFFRACTION BEAMS FROM PLATINUM SURFACES AND FROM ADSORBED OVERLAYERS. Wasilczyk, J. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-eng-48. 98p. Dep. NTIS $7.00.

Thesis.

A method for obtaining normalized relative intensities from photographs of the diffraction pattern on the screen of a Varian LEED display apparatus was developed. The optical density of the diffraction spot on the photograph is measured by a scanning microdensitometer and integrated over the area of the spot. Intensities are calculated from an experimentally determined characteristic curve for the film and then normalized by the incident beam current. Intensities of the diffraction beams from the (111) and (100) faces of platinum and from the surface structure formed by the adsorption of propene on Pt(111) were measured using this technique. The results from Pt(111) are compared with intensities calculated by programs based on LEED dynamical scattering theory and show little agreement. Some of the intensity versus voltage curves for the Pt(100) surface are compared with previous data obtained by the spot photometer technique and, for the most part, the agreement is acceptable. (auth)

23996 (LBL-1818) DIFFUSION OF GASES IN GLASS. Masaryk, J. S. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-Eng-48. 99p. Dep. NTIS $7.00.

A statistical-mechanical model of diffusion is applied to monatomic gas diffusion in fused silica. The process of diffusion is treated as a random-walk process that results in a diffusion equation in terms of the temperature, fundamental constants, and material parameters. The model is compared to data reported in the literature and obtained in this study on He, Ne, and Ar diffusion in fused silica in order to determine the unknown parameters. The model shows that the pre-exponential factor, D_0, in the Arrhenius-type expression for diffusion is independent of temperature and that absolute rate theory is not able to account for the small nonlinearity observed in log D vs 1/T plots for this system. The model has also been extended to diatomic molecules. H_2 and D_2 were studied and yielded the same results as the monatomic gases. (MCW)

23997 (LFEN-147(AB)) DETERMINATION OF THE PHONON DENSITY OF STATES IN LEAD, ALUMINIUM, AND CALCIUM BY A NEW METHOD. Gompf, F.; Lau, H.; Reichardt, W.; Salgado, J. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1973. 25p. (In Portuguese). (CONF-720464–4). Dep. NTIS (U. S. Sales Only) $3.25.

From spring meeting of the German Physical Society; Freudenstadt, Federal Republic of Germany (10 Apr 1972).

Investigations were conducted on the feasibility of measuring the phonon density of states of coherently scattering polycrystalline materials. The averaging over a large range of directions of momentum transfer was realized by using multiple-scattering processes. Measurements were performed on lead, aluminum and calcium using a rotating-crystal TOF spectrometer at the cold source of the reactor FR2 with a fixed direction of the flight path at right angles to the incident neutron beam. The experimental data were corrected for multiphonon processes and contributions due to multiple inelastic scattering using the incoherent approximation. (auth)

23998 (LRP-60/73) DOUBLE DISCHARGE HIGH-POWER TEA CO_2 LASER. Boulanger, P.; Heym, A.; Mayor, J. M.; Pietrzyk, Z. A. (Ecole Polytechnique Federale de Lausanne (Switzerland)). Feb 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

A double-discharge TEA CO_2 laser of simple design and easy operation was successfully operated; the output energy is 12 J, the power 0.5 GW of linearly polarized light. The influence of the different gas mixtures on the problem of arcing, time delay before lasing, and evolution in time of the light pulse was investigated. The addition of xylene made possible the operation of a long and narrow laser configuration. Xylene avoids the formation of arcs in a very efficient way. This permits increasing the input energy in the glow discharge. This way, 200 J/liter were fed into the glow discharge without arcing. The laser described is capable of a power output of 42 MW/cm^2 of the beam cross section. The maximum efficiency is 6.5%. (auth)

23999 (MLM-2009) EFFECTS OF GRAPHITE AND CALCIUM STEARATE ADDITIVES ON 9407 PBX. Gossett, J. D. (Mound Lab., Miamisburg, Ohio). 15 Aug 1973. Contract AT(33-1)-Gen-53. 24p. Dep. NTIS $4.00.

Six possible blends of 9407 and one standard blend of 9007 PBX were blended with varying amounts of graphite and calcium stearate and used to fabricate 16 groups of 300 pellets each. Ten groups of pellets were fabricated to a density of 1.62 g/cc while the other six groups were fabricated to a density of 1.55 g/cc. All pellets were fabricated on a Dorst press. After fabrication, the pellets from each group were individually weighed and histograms of each group's weight were prepared. Samples were chosen from each group and measured for height and diameter dimensions. The samples from each group were loaded into a special fixture and sheared to determine each group's average shear strength at the specified densities. The blend chosen was the blend containing 0.4% graphite and 0.0% calcium stearate as additives. All groups were compared to determine the effects of the calcium stearate and graphite additives. (auth)

24000 (NP-19756) LIST OF BIBLIOGRAPHIES. (Bell Labs., Holmdel, N. J. (USA)). 4 May 1973. 44p.

24001 (NP-19820) COMPARISON OF MAGNETIC STRUCTURES WITH THE SUPEREXCHANGE THEORY. Luczynska, K.; Oles, A. (Institute of Nuclear Techniques, Krakow (Poland)). Jul 1972. 10p. (INT-23). Dep. NTIS (U. S. Sales Only) $3.00.

The compilation of tables of magnetic structures determined by neutron diffraction allows the comparison of experimental structures with the theoretical predictions. As a beginning, this comparison was made for compounds of elements of the iron group NaCl, ZnS, FeS_2, Mn_4N, and perovskite-type elements. (auth)

24002 (NYO-3747-20) STRATOSPHERIC WINDS OVER AUSTRALIA, 20°S TO 40°S, 1966–1972. Final Report. Laby,

J. E.; Unthank, E. L. (Melbourne Univ., Parkville (Australia). Dept. of Physics (RAAF Academy)). Nov. 1972. Contract AT(30-1)-3747. 94p. Dep. NTIS $6.75.

Results and analyses reported herein are based on data collected to the end of 1971 under contract of the U.S.A.E.C., Biology and Fallout Division. This report updates an earlier analysis (1970), which gave details of results prior to January 1970. The data analyzed were obtained from radar-tracked neoprene balloon flights in which the balloon loads were limited to a radar target only, in order to achieve maximum height from relatively small balloons (1200 gm or less nominal weight). Several methods, including the "valve" technique of Hopper and Laby (1960) and the use of bleeder tubes, were used to further improve height performance of these balloons. (LMT)

24003 (ORNL-4883, pp 65-84) BIOCHEMICAL TECHNOLOGY. Aug 1973.

In Chemical Technology Division annual progress report for period ending March 31, 1973.

24004 (ORNL-NSF-EP-41) ENVIRO COUNTY: A GAMING SIMULATION OF REGIONAL PLANNING PROCESS. Cohan, P. H. (Cooperative Science Education Center, Inc., Oak Ridge, Tenn. (USA)). Jan 1973. Contract W-7405-eng-26. 88p. Dep. NTIS $6.50.

For Oak Ridge National Lab., TN.

24005 (ORNL-NSF-EP-54) REGIONAL MODELING ABSTRACTS. A Bibliography of Regional Analysis. Volume V. Meyers, C. R. Jr. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 384p. (ORNL-EIS-73-61). Dep. NTIS $21.25.

The fifth 1000 abstracts of literature acquired and indexed by the Regional Environmental Systems Analysis (RESA) Program of the Oak Ridge National Laboratory–National Science Foundation Environmental Program are given. The abstracts cover literature on the development and use of mathematical models capable of simulating the economic, demographic, societal, ecological, and land-use responses of a geographical region to alternative policy decisions. Access to the abstracts is achieved through various indexes: key word, author, permuted title word, and permuted key word (or phrase). (auth)

24006 (ORNL-TIRC-73-1) EFFECTS OF INSECTICIDES ON ENZYME ACTIVITY: AN ANNOTATED BIBLIOGRAPHY, 1964 TO 1972. Gerstner, H. B. (Toxicology Information Response Center, Oak Ridge, Tenn.). Aug 1973. 109p. Dep. NTIS $8.00.

This annotated bibliography of 457 selected references on pesticide–enzyme interactions was compiled from the literature sources such as Chemical Abstracts, Biological Abstracts, Index Medicus, and Toxicity Bibliography. The bibliography is directed towards the effects of insecticides on enzyme systems in humans and animals. Because the persistent organochlorine pesticides are being restricted, the enzyme-inhibiting organophosphate pesticides will enjoy wider use with a consequent increase in the incidence of adverse effects and poisonings. For this main reason, the present annotated bibliography was collected to make readily available to the scientific community pertinent references on the pesticide–enzyme inhibition activity. (LMT)

24007 (ORNL-TIRC-73-VB-6) METABOLISM OF FOREIGN COMPOUNDS: AN ANNOTATED BIBLIOGRAPHY. Verbiscar, A. J. (Toxicology Information Response Center, Oak Ridge, Tenn.). 14 Jun 1973. 27p. Dep. NTIS $5.00.

This bibliography contains 200 entries and is directed towards the effects of biological systems on exogenous substances. Its scope is limited to publications in the current literature that deal with metabolism of foreign compounds in mammalian and avian systems. Metabolism includes biological processes of absorption, distribution, biotransformation, and excretion. Studies on foreign-compound interactions affecting metabolism, enzymatic and non-enzymatic biotransformations, mechanisms, comparative metabolism, and methodology are within the scope of this bibliography. Articles on the metabolism of compounds endogenous in mammals are included when the compound in question has an actual or potential practical use or when the research results appear directly applicable to foreign compound metabolism. (auth)

24008 (ORNL-TM-4302) EFFECT OF VARIOUS RATES OF SEMICONTINUOUS DRIP IRRIGATION ON LETTUCE (LACTUCA SATIVA L.) GROWN IN GREENHOUSE. Shimshi, D.; Michel, J. W. (Oak Ridge National Lab., Tenn.). Aug 1973. Contract W-7405-eng-26. 39p. Dep. NTIS $4.00.

24009 (ORNL-tr-2677) PHOTOCHEMICAL OXIDATION OF MERCURY AND ISOTOPE SELECTIVITY. Desnoyer, M.; Nief, G.; Roth, E. Translated by P. S. Baker from J. Chim. Phys.; 60: 209-211(1963). 5p. Dep. NTIS $3.00.

Oxidation was carried out in O_2 water vapor, or CO_2, using 2,537-Å radiation. The relative abundances of the Hg isotopes other than ^{202}Hg were the same for the oxide as for the starting Hg. Effects of butadiene and N_2 were also studied. (DLC)

24010 (ORNL-tr-2685) EFFECT OF HYDROSTATIC STRESS ON CREEP AND CREEP RUPTURE OF POLYCRYSTALLINE METALS AT ELEVATED TEMPERATURES. Ohnami, M.; Yamakage, T. Translated from Zairyo; 21: No. 222, 225-231(1972). 15p. Dep. NTIS $3.00.

Results of studies on the effects of hydrostatic pressure on high-temperature tensile creep and creep-rupture life of pure polycrystalline Al are reported. Information and discussions are also included on effects of hydrostatic pressure on creep rate, effects of hydrostatic stress on creep rupture life, and experimental results. (auth)

24011 (ORNL-tr-2686) CARBIDE PRECIPITATION AND HIGH-TEMPERATURE STRENGTH OF 18-8 STAINLESS STEELS. Tanaka, R.; Shinoda, T. Translated from Zairyo; 21: 198-203 (1972). 14p. Dep. NTIS $3.00.

The relationship between the creep rupture strength and the dispersion state of precipitated carbides in 18-8 stainless steels is examined. Results of studies are reported in summary manner to demonstrate the presence of an intimate relationship between these two items. It is noted that the addition of trace quantities of Ti and Nb is particularly effective in enhancing the fine and uniform precipitation of $M_{23}C_6$ and thereby improving the creep-rupture strength. It is also mentioned that the addition of trace quantities of Ti and Nb, along with the combination of N and B to 18-10 Mo steel, results in a 700°C 10^3-h rupture strength of the order of 18.5 kg/mm^2 that is a far-greater value than normally observed in this type of steel. Results of studies made on the factors responsible for the formation of fine carbide particles as a result of the addition of trace quantities of Ti and Nb show that the fine and uniform dispersed state of carbides and associated increase in high-temperature strength is not limited to the addition of Ti and Nb to austenite steel. Such carbide dispersions can be produced by (1) selection of a chemical composition so that two or more species of MC type carbides are precipitated, along with a simultaneous precipitation of $M_{23}C_6$, and by (2) a reduction of the misfit between the matrix and the precipitating $M_{23}C_6$ to the minimum level. (auth)

24012 (ORNL-tr-2688) CREEP RUPTURE STRENGTH AND STRUCTURE OF LOW-ALLOY STEELS. Yukitoshi, T.; Nishida, K. Translated from Zairyo; 21: 204-211(1972). 14p. Dep. NTIS $3.00.

The results of the study of microstructures of creep-rupture material of ½ Mo, 1 Cr–½ Mo, 2¼ Cr–1 Mo, 5 Cr–½ Mo, and 9 Cr–1 Mo steels are summarized. It was found that an inversion in the creep rupture strength due to difference in prestructure is seen in 1 Cr–½ Mo and 2¼ Cr–1 Mo steels. Steel with high Cr content such as 5 Cr–½ Mo and 2¼ Cr–1 Mo steels. Steel with high Cr content such as 5 Cr–½ Mo, and 9 Cr–1 Mo have low creep strength compared with the low Cr–½ Mo, 1 Cr–½ Mo, and 2¼ Cr–1 Mo steels. The results of the analysis of extracted residues of the different steels indicate little change in the Cr content with annealing while there is a large change in the Mo content as a result of annealing. The increase in Mo is small in the high-Cr steels (5 Cr–½ Mo, 9 Cr–1 Mo) but this increase is very pronounced in the low Cr material (½ Mo, 1 Cr–½ Mo, 2¼ Cr–1 Mo). The precipitates in the ferrite of normalized-temper material as observed in the microstructure are finer than those in the annealed material. Looking at the pearlite section, the bainite that is found in the normalized-temper material of 2¼ Cr–1 Mo steel tends to form large particles rather readily on annealing. No precipitation of fine carbide particles is seen in the ferrite of high-Cr material. (auth)

24013 (ORNL-tr-2689) MECHANICAL BEHAVIOR OF AUSTENITIC STAINLESS STEELS. Tricot, M. Translated from Met. Constr. Mec.; 104: No. 4, 129-136(1972). 18p. Dep. NTIS $3.00.

The unusual mechanical behavior of austenitic steels in alloys is studied from the technical and economic viewpoint. Austenitic stainless steels have a superior capability to adapt to applied forces than do ordinary steels. The effects of speed of traction, heat treatment and weak hardening of various origins are discussed for the austenitic steel. An experiment on the influence of prestressing on the mechanical behavior of quenched austenitic stainless steel was performed. The peculiarities of creep of austenitic steels and the influence of composition and heat treatment on creep are discussed. A plastic deformation caused by a prior stress or caused by a previous creep under a large loading will considerably reduce the amount of creep during a later test. (5 tables, 11 figures) (MCW)

24014 (ORNL-tr-2693) CATALYTIC PROPERTIES OF RHENIUM. III. Methods of Obtaining Rhenium Catalysts. Platonov, M. S.; Tomilov, V. I. Translated from Zh. Obshch. Khim.; 7: No. 3-4, 776-777(1937). 4p. Dep. NTIS $3.00.

Two methods for obtaining finely dispersed Re were tested. Data are given on the dehydrogenation of ethyl and isopropyl alcohols using Re catalysts. (DLC)

24015 (ORNL-tr-2699) STUDIES ON 5 Cr-½ Mo, 7 Cr-½ Mo, AND 9 Cr-1 Mo STEEL FOR STEEL TUBES. Hirano, H.; Yamamoto, S.; Hiura, T.; Kobayashi, H.; Masuda, T. Translated from Tetsu to Hagane; 46: 372-375(1960). 7p. Dep. NTIS $3.00.

An investigation was made of the heat treatments necessary to give 5 Cr-½ Mo, 7 Cr-½ Mo, and 9 Cr-1 Mo steels cold-working properties and creep strength equal to or better than the ASTM mean values. It was found that the creep-strength values of the CrMo steel specimens all were at the same level or higher than the mean ASTM values. The creep strength of normalized annealed specimens gave values greater than the ASTM mean values even when their C contents were close to the lower limit of the specifications. Their hardness also came close to the levels of the ASME specifications, and their impact strengths were good compared with those subjected to other treatments. All the tested steels have high hardening properties, indicating that they require preheating before welding. (auth)

24016 (ORNL-tr-2702) CREEP PROPERTIES OF Kh18N10T STAINLESS STEEL UNDER DIFFERENT TEMPERATURE CONDITIONS. Simonyan, A. M. Translated by Martha Gerrard (Oak Ridge National Lab., TN) from Izv. Akad. Nauk Arm. SSR, Ser. Mekh.; 25: No. 2, 75-82(1972). 10p. Dep. NTIS $3.00.

Creep of stainless steel under stresses of 1560 and 96 kg/cm^2 at constant and variable temperatures ranging from 600 to 700°C was investigated. A generalized equation of creep at constant temperature for the case of variable temperature is derived from the theories of nonlinear heredity, hardening, and flow. The best agreement with experimental data under nonexothermal creep was provided by the theory of hardening in its general form. It was also shown that extinguishing part of the creep and instantaneous deformation are not reversible with temperature variation. (auth)

24017 (ORNL-tr-2706) APPARATUS FOR TESTING THE CREEP STRENGTH OF METALS IN LIQUID MEDIA. Khitarishvili, M. G.; Vasilenko, I. I.; Zhagalyak, N. N.; Melekhov, R. K.; Filevich, M. I. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from Fiz.-Khim. Mekh. Mater.; 8: No. 5, 88-90(1972). 5p. Dep. NTIS $3.00.

Apparatus with shear strengths of 40 and 30 tons for testing corrosion cracking of steel samples 18 to 25 mm in diameter was constructed. Other apparatus for simulation of heat-power equipment operating conditions and for determining the tendency of metals toward corrosion cracking by use of a cantilever arm is described. (JRD)

24018 (ORNL-tr-2709) TWO METHODS FOR CALCULATING THE ROTATIONAL CAPACITY OF PLASTIC HINGES IN REINFORCED CONCRETE STRUCTURES UNDER BENDING. Eifler, H.; Plauk, G. Translated from Materialpruefung; 14: No. 8, 256-259(1972). 12p. Dep. NTIS $3.00.

Determination of the rotational capacity is made difficult by the large number of effective parameters. It is not economically justifiable to determine the effects of all parameters experimentally. Therefore, after preliminary experiments on reinforced concrete beams, two methods for calculating the plastic deformation of reinforced concrete structures under bending were developed. The two methods have in common that they take into account the discontinuity of a cracked reinforced concrete beam as well as the displacements of the steel with respect to the concrete, and only the cross-sectional values, the stress-strain lines of the concrete and steel, and the composite behavior are essential for the calculation. (LMT)

24019 (ORO-2412-46) ANALYSIS OF DIAMORPHA SYSTEMS ON GRANITE OUTCROPS. Hay, J. D. (Emory Univ., Atlanta, GA). 1973. Contract AT(40-1)-2412. 111p. Dep. NTIS $7.75.

Thesis.

Abiotic and biotic measurements of system stability and material flow were obtained over a time period of one year on sixteen Diamorpha systems located on the Rock Chapel outcrop in Rock Chapel, Ga. The plant population of the system is composed almost entirely of Diamorpha Smallii Britton. The microarthropod populations of the system showed wide fluctuations in population numbers and were dependent upon soil moisture levels. (LMT)

24020 (ORO-2825-34) MASS SPECTRAL STUDY OF THE CATALYTIC OXIDATION OF AMMONIA, METHYLAMINE, AND HYDROGEN CYANIDE ON PALLADIUM METAL. McDow, R. S. (Vanderbilt Univ., Nashville, Tenn.). May 1971. 242p. Dep. NTIS $14.25.

Thesis.

24021 (ORO-2825-35) PULSE-LASER PULSE-MAGNET STUDY OF THE KINETICS OF NO_3 IN AQUEOUS ACID SOLUTION AND OF THE PHOTOISOMERIZATION OF STILBENE IN BENZENE SOLUTION. Stevens, M. V. (Vanderbilt Univ., Nashville, Tenn. Dept. of Chemistry). Oct 1971. 235p. Dep. NTIS $13.75.

Thesis.

20-nsec laser pulses were used to study the mechanism for the generation of NO_3 radicals by photolysis of $(NH_4)_2Ce(NO_3)_6$. The effects of a 200-kg magnetic field on the photoisomerization of stilbene in benzene were also studied. (DLC)

24022 (ORO-2825-36) ELECTRON SPIN RESONANCE STUDY OF THE FREE RADICALS GENERATED UPON PHOTOLYSIS OF Ce(IV) SALTS IN VARIOUS ACID MEDIA. Swift, L. L. (Vanderbilt Univ., Nashville, Tenn.). Dec 1971. 182p. Dep. NTIS $11.25.

Photolysis of $(NH_4)_2Ce(NO_3)_6$ in HNO_3-$HClO_4$ produces the NO_3 radical. The NO_3 radical can be generated in both a primary process and a secondary process in the same system, particularly under annealing-recooling conditions. Uv photolysis of frozen Ce-perchlorate-perchloric acid solutions at -180°C produces $(H_2O)^+$, which on annealing and recooling is replaced by the neutral H_3O species. In heavy water, H_3O, D_3O, H, and D spectra are produced upon irradiation at -180°C. The dissociations energy of H_3O is < 7 kcal/mole. ESR characteristics of NO_3, H_3O, and D_3O are given. (14 figures, 4 tables, 97 references) (DLC)

24023 (ORO-3861-9) ELECTRONIC PROPERTIES OF LIQUIDS. Annual Progress Report on Atomic Energy, November 1, 1972-October 31, 1973. Painter, L. R. (Tennessee Univ., Knoxville. Dept. of Physics). 1973. Contract AT(40-1)-3861. 45p. Dep. NTIS $4.25.

Reflectance measurements were extended on liquid water to 25.6 eV. Also, refinement of the open-dish reflectance technique permitted more accurate measurements below 15 eV than those obtained in the earlier years of this contract. Optical and dielectric data were obtained from these measurements. A prominent peak in the energy loss function at about 21.2 eV, not previously observed, was interpreted as a collective electronic oscillation. Reflectance measurements on the linear hydrocarbons tetradecane, $C_{14}H_{30}$, and heptadecane, $C_{17}H_{36}$, were repeated from 7 to 20 eV and extended to 25.6 eV. The studies on undecane, $C_{11}H_{24}$, were discontinued due to difficulties associated with maintaining this high-vapor-pressure, low-surface-tension liquid in near vacuum conditions. Construction of new equipment and modification of existing equipment are discussed. (MOW)

24024 (ORO-3992-115) MANY-TIME PHOTOCOUNT DISTRIBUTIONS. Srinivasan, S. K.; Sukavanam, S.; Sudarshan, E. C. G. (Texas Univ., Austin. Center for Particle Theory). 1971. 12p. (CPT-169). Dep. NTIS $3.00.

The generating function for N photocounts for a gaussian optical field with a Lorentzian profile is given without any restriction to the intervals during which the photodetectors are open. The method may be generalized to arbitrary spectral profiles using the method of Srinivasan and Sukavanam (Phys. Lett., 35A: 81(1971)). (auth)

24025 (ORO-4254-11) DETERMINATION OF PHENOLIC-TYPE COMPOUNDS IN WATER AND INDUSTRIAL WASTE WATERS. Kelly, J. A. (Oklahoma State Univ., Stillwater). 1972. 28p. Dep. NTIS $3.50.

After a literature review of methods, a proposal is given for the development of an improved uv-absorption technique employing high-pressure liquid chromatography. 45 references. (DLC)

24026 (ORO-4254-15) DETERMINATION OF PHENOLIC-TYPE COMPOUNDS IN WATER BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY. Kelly, J. A. (Oklahoma State Univ., Stillwater). Jul 1973. Contract AT(40-1)-4254. 103p. Dep. NTIS $7.25.

Thesis.

In recent years, increasing attention has been given to the problem of water pollution control in natural waters and waste water. Coinciding with this trend in more stringent pollution abatement is the need for analytical procedures that permit identification and quantification of phenolic-type contaminants in the milligrams-per-liter to micrograms-per-liter, or lower, concentration range. Analytical studies of trace phenols have been deterred by their low concentration and the complexity of the organic constituents in aqueous media. Most methods require a minimum of one milligram of a single compound for positive identification.

Instrumental procedures which are most promising at present involve spectrophotometric and chromatographic techniques. These systems lack the sensitivity to analyze the organic directly at the level found in natural and waste waters. Preliminary concentration of phenols which does not alter the individual constituents or their relative distribution is essential. This investigation includes an evaluation of existing procedures using prepared standards containing alkyl, chloro, amino, and naturally occurring phenols. Information obtained will be utilized in the development of an improved fluorescence technique employing high-pressure liquid chromatography. (57 references) (DLC)

24027 (PRNC-162(App.), pp 366-371) BIOMASS AND PRODUCTION OF PHYTOPLANKTON IN JOBOS BAY. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24028 (PRNC-162(App.), pp 372-379) MEASUREMENT OF BIOMASS AND PRODUCTIVITY OF PHYTOPLANKTON. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24029 (PRNC-162(App.), pp 380-382) MEASUREMENT OF PRODUCTIVITY OF BENTHIC ALGAE. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24030 (PRNC-162(App.), pp 383-385) MEASUREMENT OF PRODUCTIVITY OF SEA GRASSES. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24031 (PRNC-162(App.), pp 386-390) PHYSICAL OCEANOGRAPHIC METHODS. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24032 (PRNC-162(App.), pp 391-404) COLLECTION AND PREPARATIVE METHODS. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24033 (PRNC-162(App.), pp 405-409) COLLECTION AND PREPARATION OF BIOLOGICAL SAMPLES FOR TRACE ELEMENT, NUTRIENT, AND CHN ANALYSIS. Mar 1973.
In Aguirre power project environmental studies 1972 annual report.

24034 (SC-RR-70-790) GURNEY ENERGY OF EXPLOSIVES: ESTIMATION OF THE VELOCITY AND IMPULSE IMPARTED TO DRIVEN METAL. Kennedy, J. E. (Sandia Labs., Albuquerque, N. Mex.). Dec 1970. 35p. Dep. NTIS $3.75.
The Gurney method, which yields simple equations for evaluating the velocity of metals driven by detonating explosives in many geometries, is reviewed. The method is extended by relating the specific impulse of an explosive to its Gurney energy parameter, and by noting that for most explosives the Gurney energy is a nearly constant proportion of the chemical energy. Several diverse examples illustrate application of the Gurney equations in the utilization of explosives. (auth)

24035 (SC-RR-72-385) EXPERIMENTAL DETERMINATION OF PHASE TRANSFORMATION RATES IN SHOCKED POTASSIUM CHLORIDE. Hayes, D. B. (Sandia Labs., Albuquerque, N. Mex.). Aug 1973. 107p. Dep. NTIS $5.45.
Thesis. Submitted to Washington State Univ.
Single crystals of potassium chloride (KCl) were impacted on quartz gages with velocities from 0.0363 to 0.755 cm/μsec, producing plane shocks with stress amplitudes from 17 to 31 kbar. Stresses greater than about 21 kbar are sufficient to induce a polymorphic phase transition in KCl. For impact stress in excess of that threshold, the theory of continuum mechanics is used to relate stress relaxation at the impact surface to transformation rate between the phases. Results depend upon crystallographic orientation of the KCl. (LMT)

24036 (SCL-DC-720079) INSTABILITY OF DIFFERENCE METHODS FOR CYLINDRICAL AND SPHERICAL ELASTIC WAVES. Chiu, S. S.; Marx, K. D. (Sandia Labs., Livermore, Calif.). Jan 1973. Contract AT(29-1)-789. 35p. (CONF-730818-1). Dep. NTIS $3.75.
From 13th midwestern mechanics conference; Pittsburgh, Pennsylvania, USA (13 Aug 1973).
This paper deals with the stability of the explicit finite-difference method of Chou and Greif (AIAA J., 6: 1067(1964)) for studying cylindrical and spherical elastic waves. The method has been found empirically to exhibit instabilities after long times. A stability analysis is carried out for this scheme, as well as for the centered difference scheme for the equivalent equation in one dependent variable. Both of these methods are shown to be unconditionally unstable; however, the instability growth rates may be so small that acceptable results can be obtained in problems of moderate time duration. The analogous difference schemes for plane waves are stable if the Courant condition $c\Delta t/\Delta r \leq 1$ is satisfied. The fact that the schemes for the nonplanar cases are always unstable emphasizes the danger of arbitrarily extending an unproved stability criterion. (auth)

24037 (SCL-DC-720305) DENSE FLUID TRANSPORT VIA NONEQUILIBRIUM MOLECULAR DYNAMICS. I. Shear Viscosity. Ashurst, W. T.; Hoover, W. G. (Sandia Labs., Livermore, Calif.). Mar 1973. Contract AT(29-1)-789. 38p. (CONF-730101-2). Dep. NTIS $4.00.
From symposium on application of computers to fluid dynamic analysis and design; Farmingdale, New York, USA (3 Jan 1973).
A novel fluid transport calculation by computer simulation, via nonequilibrium molecular dynamics, of laboratory methods of transport measurement is described. Shear viscosity of soft-spheres (r^{-12} potential) and Lennard-Jones particles (r^{-12}–r^{-6} potential) was obtained from molecular dynamic modeling of Couette flow. (MOW)

24038 (SLA-73-505) ANISOTROPIC HUGONIOTS OF CLOTH-LAMINATE QUARTZ PHENOLIC (0, 45, AND 90° LAY-UP ANGLES). Munson, D. E. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 33p. Dep. NTIS $3.75.
The Hugoniots for three orientations, 0, 45, and 90° lay-up angles, of a special low-porosity, cloth-laminate quartz phenolic were determined to 40 kbars by plate-impact techniques. These Hugoniots showed a marked material anisotropy. The 0° orientation was the weakest material. The strength increased slightly in the 45° orientation and markedly in the 90° orientation. As the stress level increased, the relative anisotropy effect decreased, until it was no longer observable within the uncertainty of the tests. Static tests of the composite under uniaxial strain conditions to 5 kbars gave nearly the same strength effects with lay-up angle as the dynamic tests. The exceptional agreement of dynamic and static results indicates that rate effects are unimportant in this composite. In the static tests strong material hysteresis was observed from the 0 and 45° lay-up angles, while little hysteresis was observed at the 90° lay-up angle. This has been partially confirmed by dynamic data and has a simple mechanical explanation. (auth)

24039 (SLA-73-603) PREPARATION, ANALYSIS, AND EXPLOSIVE EVALUATION OF ISOTHIOCYANATOPENTAMMINE-COBALT (III) PERCHLORATE. Formal Report, 21 March 1961–22 March 1962. (Universal Match Corp., St. Louis, MO. Armament Div.). 26 Mar 1962. 81p. Dep. NTIS $6.25.

24040 (SLA-73-669) AIRCRAFT-VELOCITY MEASUREMENT THROUGH RADAR-ALTIMETER ECHO: A THEORETICAL INVESTIGATION. Williams, C. S. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 36p. Dep. NTIS $4.00.
An examination of the character of the fading of the echo of a radar altimeter indicates that it might be used to obtain aircraft velocity with considerable accuracy. This preliminary examination considers neither the hardware problems nor the problems that an extremely rough terrain might cause. (auth)

24041 (SLA-73-749) THREE-COMPONENT MEASUREMENTS ON FLEXIBLE MODELS OF THE STABILIZING PARACHUTES FIST, KOSTELEZKY, RIBLESS GUIDE SURFACE, AND RINGSLOT. Doherr, K.-F.; Schmerwitz, D. 30 Mar 1973. Translation of IB-154-73/7. 53p. Dep. NTIS $4.75.
In the low-velocity wind tunnel of the German Research and Testing Establishment for Aeronautics and Astronautics in Braunschweig, the lift, drag, static stability, and center of pressure of stabilizing parachutes were investigated on flexible models of the parachutes "Ribless Guide Surface," "Ringslot," "FIST," and "Kostelezky." The aerodynamic forces were measured by means of a three-component balance developed at the Institute for Flight Mechanics. (auth)

24042 (SLL-73-20) HIGH-ENERGY-RATE FORMING STUDIES OF TWO EXPERIMENTAL A286-TYPE STAINLESS STEEL ALLOYS. Lindsay, P. B. (Sandia Labs., Livermore, Calif.). Jul 1973. Contract AT(29-1)-789. 26p. Dep. NTIS $3.50.
The strengthening response of two experimental A286 type alloys to a high-energy-rate forming (HERF) process was investigated and compared to similar studies conducted on the conventional A286 material. The combination of HERF forging and aging of the experimental alloys produced only a slight strength increase with a significant loss in ductility. (auth)

24043 (SLL-73-24) DEVELOPMENT OF MODIFIED A286 AUSTENITIC STAINLESS STEEL. Lindsay, P. B. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 43p. Dep. NTIS $4.25.

Modifications were made to the chemistry and processing of A286 austenitic stainless steel in order to develop two experimental alloys, which were then analyzed for weldability, mechanical properties at room temperature, and compatibility with hydrogen. The two alloys showed higher yield strength and improved weldability over A286. Charging with hydrogen caused a 20% loss in reduction in area for Alloys A and B, while A286 showed only a 7% loss. All three alloys showed ductile-type failures in the charged and uncharged samples. (9 tables, 26 figures) (auth)

24044 (SLL-73-42) CORROSION, THERMAL STRESSING, AND MISCELLANEOUS PLATING STUDIES WITH AN ELECTROPLATED JOINT. Dini, J. W. (Sandia Labs., Albuquerque, N. Mex.). Jul 1973. 23p. Dep. NTIS $3.25.

Corrosion and heat-treating studies were used to assess the integrity of an aluminum-to-stainless steel joint made by electroplating with nickel. In addition, the influence of various plating parameters on nickel adhesion was studied. (auth)

24045 (SLL-73-45) DYNAMIC BUCKLING OF THIN ALUMINUM, CIRCULAR CYLINDRICAL SHELLS SUBJECTED TO A UNIFORM IMPULSE LOADING. Wesenberg, D. L. (Sandia Labs., Livermore, Calif.). Aug 1973. Contract AT(29-1)-789. 53p. Dep. NTIS $4.75.

The dynamic buckling of a series of thin 6061-T4 aluminum, circular cylindrical shells was investigated. UNIVALVE, a Sandia dynamic elastic-plastic ring code, was modified to predict both early-time dynamic buckling response and late-time permanent buckle deformation. The magnetic induction technique was then used to subject shells with radius-to-thickness ratios of 100, 200, and 300 to uniformly distributed impulse loading. Good correlation was obtained between the numerical predictions and the experimental measurements of applied impulse, permanent buckle deformation, and buckle wave numbers. (24 figures, 26 references) (auth)

24046 (SRARI-P-180) SYNTHESIS OF A ZIRCONIUM-PHOSPHATE BASED ION EXCHANGER IN NITRIC ACID SOLUTIONS. Degtyareva, A. B.; Korshunov, I. A.; Chernorukov, N. G.; Shafiev, A. I.; Efremov, Yu. V.; Yakovlev, G. N. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

24047 (SRO-525-6) ION EXCHANGE MEMBRANES. Progress Report, October 1, 1972–September 30, 1973. Baker, B. L. (South Carolina Univ., Columbia. Coll. of Engineering). 6 Jul 1973. Contract AT(38-1)-525. 20p. Dep. NTIS $3.00.

Progress is reported on a study of ion exchange membranes for the concentration and/or for the separation of ions. Theoretical considerations along with the data collected and analyzed during the past year indicate the following: a transfer unit concept can be used to design membrane systems for separating ions; chelating agents and in particular the sodium salt of ethylenediamine tetraacetic acid can be used in a cation exchange membrane system to separate ions of the same charge as well as ions of different charge. A flowsheet for the removal of zinc and iron(III) from calcium, magnesium and sodium ions was experimentally demonstrated. A flowsheet for the separation of divalent ions Cu(II), Fe(II) and Zn(II) was shown experimentally. (auth)

24048 (SRO-643-8) RNA METABOLISM IN THE REGULATION OF PROTEIN SYNTHESIS. Progress Report, June 1, 1972–June 1, 1973. Key, J. L. (Georgia Univ., Athens). 1973. Contract AT(38-1)-643. 12p. Dep. NTIS $3.00.

24049 (UCD-34-P-200-X-1) GENETIC STRUCTURE OF NATURAL POPULATIONS. Progress Report. Dobzhansky, T.; Ayala, F. J. (California Univ., Davis. Dept. of Genetics). 30 Jul 1973. Contract AT(04-3)-34. 16p. Dep. NTIS $3.00.

Preliminary experiments carried out in this laboratory with Drosophila pseudoobscura and D. willistoni have shown that, under population conditions, flies homozygous for randomly sampled (but excluding lethal) chromosomes have fitness that is only about one third, on the average, of the fitness of individuals heterozygous for random combinations of the same chromosomes. In the fall of 1971 a large-scale experiment was started with D. melanogaster to verify and extend such results. A partial summary of the estimates of fitness and of fitness components are presented here, together with preliminary speculations concerning the significance of the results. (LMT)

24050 (UCID-16225) IMPROVED CELLULAR SILICONES. Aspey, S. A. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Feb 1973. Contract W-7405-Eng-48. 58p. Dep. NTIS $5.00.

Trimethyl-silyl end-blocked polymers were adjusted to produce improved load properties, processibility, shelf-life, and resistance to compression set. (DLC)

24051 (UCID-16287) ANALYSIS OF PENTAERYTHRITOL TETRANITRATE (PETN) FOR TRACE HOMOLOGS BY GEL PERMEATION CHROMATOGRAPHY. Clarkson, J. E. (California Univ., Livermore. Lawrence Livermore Lab.). Jun 1973. Contract W-7405-eng-48. 17p. Dep. NTIS $3.00.

24052 (UCID-16311) QUASI-STATIC ISOBARIC HEATING TEST OF THREE-PHASE EQUATION OF STATE FOR ALUMINUM. Winslow, A. M. (California Univ., Livermore. Lawrence Livermore Lab.). Jun 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $3.00.

The Al equation of state (EOS 816) used in laser effects calculations was obtained earlier from the three-phase EOS program GRAY (UCRL-51121). EOS 816 was tested by performing calculations using only EOS tables. It was found that EOS 816 gives a fair reproduction of the changes of phase of aluminum during melting and vaporization at $p = 1$ bar. The most significant error is the lack of thermodynamic consistency. A smoother behavior of $p(T,\rho)$, where p is pressure, T is temperature, and ρ is density is desirable. (JRD)

24053 (UCLA-34-P-91-64) PHOSPHORESCENCE-MICROWAVE DOUBLE RESONANCE SPECTROSCOPY. El-Sayed, M. A. (California Univ., Los Angeles. Dept. of Chemistry). 1972. 22p. Dep. NTIS $3.25.

Microwave radiation of the proper frequency can affect the phosphorescence of triplets in organic molecules at low temperatures. A brief account is given of the basic theory of this effect and its application in studying the properties of molecules and solids. (DLC)

24054 (UCLA-34-P-91-65) PHOSPHORESCENCE-MICROWAVE MULTIPLE RESONANCE SPECTROSCOPY OF POLYATOMIC MOLECULES. Annual Report, September 15, 1972–September 14, 1973. El-Sayed, M. A. (California Univ., Los Angeles. Dept. of Chemistry). May 1973. Contract AT(04-3)-34. 8p. Dep. NTIS $3.00.

Work in the following areas is summarized: nonradiative processes, spectroscopy, and structural determination of the geometry of the lowest triplet state. (DLC)

24055 (UCLA-34-P-172-9) COARSENING OF γ' PRECIPITATES AT LARGE VOLUME FRACTIONS. Chellman, D. J.; Ardell, A. J. (California Univ., Los Angeles. Dept. of Materials). Jul 1973. Contract AT(04-3)-34. 42p. (UCLA-ENG-7351). Dep. NTIS $4.25.

The kinetics of growth of the γ' precipitate in binary Ni–7, 8, 9, and 9.9 wt % Al alloys, containing γ' volume fractions ranging from 0.09 to 0.60 at the aging temperature of 800°C, were studied by magnetic analysis and transmission electron microscopy. The coarsening of γ' precipitates in ternary Ni–16.9 wt % Cr–3.4 wt % Al and 14.2 wt % Cr–4.9 wt % Al alloys aged at 750°C was investigated by transmission electron microscopy. A recent modification of the Lifshitz–Slyozov–Wagner theory (the MLSW theory) of diffusion-controlled particle coarsening predicts a pronounced effect of volume fraction on the kinetics of coarsening and on the distribution of particle sizes. The results convincingly demonstrate that the volume fraction of γ' precipitate has no effect at all on its coarsening behavior. (6 tables, 10 figures, 34 references) (MCW)

24056 (UCRL-51330) THERMO-MECHANICAL RESPONSE OF POROUS CARBON. Holt, A. C.; Kusubov, A. S.; Young, D. A.; Gust, W. H. (California Univ., Livermore. Lawrence Livermore Lab.). 22 Mar 1973. Contract W-7405-eng-48. 76p. Dep. NTIS $5.45.

The equation of state and the mechanical response of porous carbon were studied theoretically and experimentally. The experimental studies were performed on two porous carbon materials and included measurements of static P–V, high-pressure Hugoniot, and transmitted wave profiles. A three-phase carbon equation of state was constructed, based on available data from the literature and chemical-equilibrium calculations. The carbon equation of state was used with a P-alpha-dot model to calculate the results of transmitted wave measurements. Reasonably good agreement between theory and experiment has been obtained. The equation of state and porous model have been incorporated into a computer subroutine which may be used to calculate the thermo-mechanical response of porous carbon materials. (9 tables, 59 figures, 44 references)

24057 (UCRL-51392) SURFACE WAVE ANTENNA STUDY: PHASE I. Summary Report. Lytle, R. J.; Deadrick, F. J.; Miller, E. K.; Lager, D. L.; Landt, J. A. (California Univ.,

Livermore. Lawrence Livermore Lab.). 1 May 1973. Contract W-7405-eng-48. 43p. Dep. NTIS $4.00.

This report contains results obtained from the numerical evaluation of antennas that launch or receive a surface wave. The goal was to determine the most suitable surface wave antenna(s) for the frequency range of 7 to 11 MHz. The study is based upon application of computer modeling and numerical analysis procedures to antennas in proximity to ground. Both buried and elevated antennas have been considered. Elementary antennas (loops, dipoles, monopoles) as well as specific antennas (Beverage, Lambda, Yagi) were evaluated both individually and in arrays. The electromagnetic and nonelectromagnetic characteristics of the antenna system important from an overall system viewpoint are discussed. Finally, the relative advantages of the more efficient antennas are presented in the context of the surface wave system requirements and site characteristics. (auth)

24058 (UCRL-51399) FOUR-TEMPERATURE KINETIC MODEL FOR A CO_2 LASER AMPLIFIER. Harrach, R. J.; Einwohner, T. H. (California Univ., Livermore. Lawrence Livermore Lab.). 30 May 1973. Contract W-7405-Eng-48. 54p. Dep. NTIS $4.75.

A four-temperature (4-T) kinetic model is derived for a CO_2 electric-discharge laser amplifier, taking account of the effects of additive gases nitrogen and helium, radiation terms, and the temperature dependence of vibrational energy transfer rates. The characteristic temperatures of the 4-T model are the gas translational temperature, T_g, two separate vibrational temperatures for CO_2, and one vibrational temperature for nitrogen. One of the CO_2 temperatures refers to the asymmetric stretch ($\nu 3$) mode, and the second to the bending ($\nu 2$) and symmetric stretch ($\nu 1$) modes, which are assumed to be in equilibrium. The specific case of electric-discharge initiation by a pulse of high-energy electrons is studied, allowing for electronic excitation of nitrogen molecules and all three modes of CO_2. The electronic excitation rate coefficients are not derived, but rather are required input parameters for the model. Examples of results predicted by the 4-T model are given, including a comparison with experimental data reported for a LASL electron-beam-initiated device, a brief sampling of the effects of changing the initial gas pressure, and a look at effects of gain saturation for high-input pulse intensities. Detailed instructions are provided for running the computer code CO2L4T, which solves the coupled nonlinear rate equations of the 4-T model. The code contains 18 variable parameters that specify the amplifier system. (auth)

24059 (UCRL-Trans-1500) ELUTION OF CADMIUM IN ORGANS INTO FORMOL SOLUTION. Katagiri, Y.; Tati, M. Translated from Igaku To Seibutsugaku; 82: No. 1, 29-32(1971). 7p. Dep. NTIS $3.00.

During storage of organs in formal solutions, the cadmium in the organs is eluted. Percentages are ~3.5 and 9% after 1 and 10 weeks, respectively. (auth)

24060 (UCRL-Trans-1501) MEASUREMENT OF ABERRATION COEFFICIENTS OF MAGNETIC ELECTRON LENSES. Tsuyoshi, M.; Tsutomu, K. Translated from J. Electron Microsc. (Tokyo); 21: No. 3, 163-168(1972). 15p. Dep. NTIS $3.00.

Aberrations from final electron micrographs, in which a lateral displacement appears in between the bright and dark field images of crystalline specimens due to the aberrations, were measured directly. It is confirmed from the experiment that the aberrations decrease as increasing the lens excitation $NI/\sqrt{Vr}$; especially the spherical aberration coefficient decreases continuously, even though the magnetic field strength in the lens gap is almost saturated. The measured values of aberrations do not agree well with values calculated on the basis of the magnetic field distribution of the lens. (auth)

24061 (UCRL-Trans-10688) KINETICS OF THE ABSORPTION OF HYDROGEN BY TITANIUM. Grodshtein, A. E. Translated from Izv. Sib. Otd. Akad. Nauk SSSR; No. 1, 43-48(1962). 12p. Dep. NTIS $3.00.

Results of investigations show that at temperatures ranging from 300 to 800°C and pressures of below 10^{-3} mm Hg, hydrogen absorption proceeds with the formation of an α-solution of the gas in the metal. The gas is absorbed by the titanium until a maximum equilibrium concentration is reached, whose magnitude is determined by the temperature of the metal and by the hydrogen pressure of the system, and can be calculated. (JRD)

24062 (UCRL-Trans-10695) SOURCES OF INTERFERENCE IN THE REFERENCE ELECTRODE IN pH MEASUREMENTS. Galster, H. Translated from Z. Anal. Chem.; 245: 62-67(1969). 16p. Dep. NTIS $3.00.

With ground connection, the reference electrode is responsible for the conduction of stray currents out of the amplifier with resultant overloading. Improvement is possible if the size of the metal/salt solution phase boundary is increased. The difficulties resulting from an excessively high resistance of the reference electrode may be solved using a slit diaphragm. (DLC)

24063 (UCRL-Trans-10696) CALCULATION OF THE EQUIVALENCE POINT OF POTENTIOMETRIC TITRATIONS INCLUDING PROGRAMMING. Wolf, S. Translated from Z. Anal. Chem.; 250: 13-17(1970). 12p. Dep. NTIS $3.00.

24064 (UCSD-34-P-84-X-7) MARINE GEOCHEMISTRY RESEARCH. Progress Report. (Scripps Institution of Oceanography, La Jolla, Calif.). 15 Mar 1973. Contract AT(04-3)-34. 8p. Dep. NTIS $3.00.

During the contract year 1972-73 measurement of heavy element fluxes to the coastal marine environment of the western United States was carried out. The sediments of the basins off the coast of California accumulate at rates of the order of millimeters per year on the basis of ^{210}Pb geochronologies, developed under this contract. These rapid depositional rates provide enough material to allow annual fluxes to be determined. The application of ^{210}Pb geochronologies was extended from the California coastal deposits to those of Baja California, South America, the North Sea and the Baltic Sea. The method is useful for sedimentation studies over a time period of the last century. A measure of the redox potential of seawaters through the couple iodide/iodate was sought. A new polarographic method to assay both iodate and iodide was developed, the ratio of the iodine species possibly being a reliable indicator of the Eh of sea waters. (LMT)

24065 (UR-3490-189) OCCUPATIONAL ASPECTS OF NONIONIZING RADIANT ENERGY EXPOSURE, THRESHOLDS AND STANDARDS. Michaelson, S. M. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 1973. 25p. (CONF-730723-1). Dep. NTIS $3.25.

From 8th inter-American conference of toxicology and occupational medicine; Miami, Florida, USA (8 Jul 1973).

24066 (UR-3490-235) CRITICAL REVIEW OF THE BIOLOGICAL EFFECTS OF ELECTRIC AND MAGNETIC FIELDS. Kaufman, G. E.; Michaelson, S. M. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 29p. (CONF-720227-1). Dep. NTIS $3.50.

From symposium on the effects of low-frequency magnetic and electric fields on biological communication processes; Aspen, Colorado, USA (18 Feb 1972).

24067 (UR-3490-310) QUANTITATIVE ANALYSIS OF BIOLOGICAL MATERIAL USING COMPUTER CORRECTION OF X-RAY INTENSITIES. Warner, R. R.; Coleman, J. R. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 23p. (CONF-730461-2). Dep. NTIS $3.25.

From conference on electron probe analysis of cells and tissues; Seattle, Washington, USA (29 Apr 1973).

Three quantitative procedures utilizing computer programs was devised for the analysis of biological specimens. These programs are based on conventional quantitative techniques of the metallurgical and mineralogical fields. Each program is applicable to a particular set of parameters commonly encountered in biological analyses. The programs written in Fortran IV, are easy to use, require no instrument modifications or special techniques, use conventional and convenient metallurgical and mineralogical standards, and can be used to model biological samples in order to establish optimum analytical conditions or evaluate the effect of assumptions. (auth)

24068 (UR-3490-311) APPLICATION OF MICROPROBE ANALYSIS TO INTESTINAL CALCIUM TRANSPORT. Warner, R. R.; Coleman, J. R. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 21p. (CONF-730461-3). Dep. NTIS $3.25.

From conference on electron probe analysis of cells and tissues; Seattle, Washington, USA (29 Apr 1973).

24069 (UR-3490-339) PROBLEMS INVOLVED IN THE APPLICATION OF ELECTROPHORESIS TO THE TAXONOMY OF FUNGI. Reddy, M. M. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 1973. 15p. (CONF-730650-1). Dep. NTIS $3.00.

From American institute of biological sciences meeting; Amherst, Massachusetts, USA (21 Jun 1973).

24070 (UR-3490-343) CHEMICAL APPROACH TO THE LOCALIZATION OF ANION PERMEATION SITES IN THE MEMBRANE OF HUMAN ERYTHROCYTES. Cabantchik, Z. I. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1973. 202p. Dep. NTIS $12.25.

Thesis.

The chemical nature of the anion permeability sites in human red blood cells was studied with probes designed to interact with amino groups on the outer surface of the membrane and to inhibit the permeability. The effectiveness of different disulfonic stilbene probes depends on their electrostatic, covalent, and hydrophobic characteristics. A bifunctional and fluorescent analog carrying a radioactive tracer (DIDS) was found to inactivate more than 90% of the exchange component of anion permeability (chloride and sulfate) when only 200,000 molecules are bound to the membrane. (LMT)

24071 (UR-3490-346) ELECTRON PROBE ANALYSIS OF CALCIUM RICH LIPID DROPLETS IN PROTOZOA. Coleman, J. R.; Nilsson, J. R.; Warner, R. R. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd] 22p. (CONF-730461-1). Dep. NTIS $3.25.

From conference on electron probe analysis of cells and tissues; Seattle, Washington, USA (29 Apr 1973).

24072 (Y-1914) SYSTEM FOR MEASURING NORMAL SPECTRAL EMITTANCE AT HIGH TEMPERATURES. Hylton, J. O. (Oak Ridge Y-12 Plant, Tenn. (USA)). 6 Aug 1973. Contract W-7405-eng-26. 92p. Dep. NTIS $5.45.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

A system for measuring the normal spectral emittance of refractory materials was built and tested. Measurements were made on selected materials at temperatures ranging from 1200 to 2500°K and at wavelengths ranging from 0.5 to 1.6 microns. The emittance was measured by comparing the energy radiated from a small spot on the sample surface with the energy radiated from a cylindrical cavity in a graphite block which served as the sample holder. The sample and the graphite reference block were heated by radiation in a vacuum furnace. A method was devised to measure the small temperature gradient occuring in the block and correct for its effect. A comparison with literature data shows sufficient agreement to conclude that the measurements made with this system and the analytical corrections are correct. (auth)

24073 MANAGEMENT OVERSIGHT AND RISK TREE: MORT (INCLUDING SYSTEMS DEVELOPED BY THE IDAHO OPERATIONS OFFICE AND AEROJET NUCLEAR COMPANY). Johnson, W. G. Contract AT(04-3)-821. Washington, DC; Atomic Energy Commission (1973). 603p. (SAN-821-2). GPO $5.30.

24074 STEREOMATRIX DISPLAY (ENGINEERING MATERIALS). (Chicago Operations Office (AEC), Ill.). (CAPE-2344). 12 drawings.

A random-access, three-dimensional laser display called Stereomatrix was built by a group in the Department of Computer Science at the University of Illinois. Three-dimensional wire figures are displayed by generating separate images for the left and right eyes. The light from the laser is split into two beams, and then the polarization of the left beam is rotated 90°. Both beams are deflected along the x and y axis, resulting in a double image. The observer wears glasses with oppositely polarized lenses which give the visual effect of a third dimension. The observer's position is sensed by an infrared light source contained on the glasses. Movements of the observer are detected and automatic redisplaying of the figure as it would appear to the observer from the new position occurs. The observer also may scale, rotate, and translate the picture under complete hardware control. A three-dimensional cursor is also displayed by the hardware. See also COO-1469-0202. (auth)

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November 15–19, 1971

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